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ABNORMAL SUMMERS IN THE UNITED STATES

By ALFRED J. HENRY

For several years past the public prints have carried predictions that the years 1926 and 1927 might see a return of the summerless year 1816, a year which according to the same authority was a calamitous one to the farmers in the United States and elsewhere on the continent of North America.

The purpose of this paper is to present the known facts concerning the severity of the summer of 1816 and to allocate the summers of 1926 and 1927 to their proper rank among the summers of the nineteenth century.

At the outset the summer of 1926 may be dismissed as an average one without distinguishing features of note. The summer of 1927, on the other hand, was out of the ordinary run of summers and by summer is meant the months of June, July, and August. June, 1927, was cool in the north and warm in the south about in the proportion, areas considered, of 1 to 1; July was close to normal, being slightly below in some areas and above in others.

August, due to an excess of cloudiness causing low day temperatures, had a monthly mean that for a large part of the Northern and Central States east of the Rocky Mountains must be classed as one of the coolest months of the name in the last fifty-odd years. So much for the three single months of the 1927 summer.

The mean temperature of the summer season is found by taking the mean of the three summer months; thus, using Washington, D. C., as an example, the mean of June was 68.6°; July, 76.4°; August, 70°; mean for the summer; 71.7° or 3° below the normal for Washington. If, however, the astronomical summer be considered—June 21 to September 23—the depression below the normal is but 1° F.

I have computed and placed on record, for use in the years that are to come, the mean summer temperatures at 25 representative stations throughout the United States, including in this group the records for New Haven, Conn., and New Bedford, Mass., two stations that have the distinction of possessing fairly homogeneous temperature records going back more than 100 years; both include the record of the year 1816 and thus afford the unique opportunity of comparing the temperatures as observed at those stations in that year with those observed in subsequent years.

The summers have been arranged in the order of magnitude of the abnormality in each of the two groups, cool and warm summers, respectively, and are shown in Table 1 below.

TABLE 1.—*Departures from the normal of the mean summer temperatures in the coolest and the warmest summers, respectively, at 25 representative stations in the United States*

No.	New Haven, Conn. (100 years)				New Bedford, Mass. (100 years)				St. Louis, Mo. (90 years)				St. Paul, Minn. (107 years)				New York City (55 years)			
	Cool		Warm		Cool		Warm		Cool		Warm		Cool		Warm		Cool		Warm	
	Year	Depression	Year	Excess	Year	Depression	Year	Excess	Year	Depression	Year	Excess	Year	Depression	Year	Excess	Year	Depression	Year	Excess
1	1816	−4.2	1876	4.8	1816	−4.8	1825	3.2	1915	−4.4	1891	5.4	1842	−5.9	1830	5.2	1903	−2.6	1901	3.3
2	1903	−3.9	1831	3.2	1836	−3.6	1831	3.2	1863	−3.1	1914	3.7	1915	−4.5	1821	4.0	1886	−2.1	1900	2.8
3	1817	−3.0	1877	3.1	1837	−3.1	1906	2.6	1875	−3.1	1854	3.4	1844	−3.9	1894	3.9	1897	−2.0	1872	2.3
4	1836	−3.0	1864	2.8	1903	−3.1	1876	2.3	1904	−3.1	1913	3.4	1860	−3.7	1921	3.9	1915	−1.9	1906	2.2
5	1859	−2.8	1828	2.3	1891	−2.7	1820	2.1	1839	−2.9	1881	3.3	1863	−3.7	1901	3.8	1881	−1.7	1892	1.9
6	1837	−2.4	1825	2.3	1842	−2.5	1838	2.0	1889	−2.7	1837	2.7	1843	−3.4	1823	3.7	1926	−1.4	1908	1.9
7	1857	−2.4	1880	2.3	1890	−2.5	1911	2.0	1842	−2.6	1887	2.7	1859	−3.4	1850	3.5	1916	−1.2	1876	1.5
8	1832	−2.2	1841	2.2	1829	−2.3	1912	2.0	1910	−2.5	1921	2.4	1865	−3.4	1828	3.3	1885	−0.9	1894	1.5
9	1902	−2.2	1845	2.0	1893	−2.3	1854	1.9	1848	−2.2	1871	2.3	1866	−3.1	1825	3.2	1914	−0.9	1899	1.5
10	1833	−2.1	1870	1.9	1822	−2.2	1909	1.9	1891	−2.2	1850	2.1	1924	−3.0	1838	3.0				
11	1869	−2.1	1875	1.8	1832	−2.2	1819	1.6	1912	−2.2	1918	2.1	1862	−3.0	1900	3.0				
12	1886	−2.1	1878	1.8	1839	−2.1	1865	1.6	1855	−2.1	1858	2.0	1891	−2.9	1822	2.9				
13	1890	−1.9	1871	1.6	1888	−2.1	1880	1.6	1883	−2.1	1864	2.0	1848	−2.7	1829	2.9				
14	1891	−1.9	1813	1.5	1902	−2.1	1877	1.5	1882	−2.0	1874	2.0	1904	−2.7	1881	2.9				
15	1835	−1.7	1863	1.4	1904	−2.1	1828	1.4	1852	−1.8	1839	1.9	1861	−2.6	1834	2.8				
16	1889	−1.7	1838	1.3	1833	−2.0	1900	1.2	1924	−1.8	1899	1.8	1869	−2.5	1889	2.5				
17	1897	−1.7	1868	1.3	1881	−1.9	1910	1.2	1849	−1.7	1867	1.7	1903	−2.5	1856	2.4				
18	1843	−1.6	1879	1.3	1884	−1.8	1818	1.1	1906	−1.7	1900	1.7	1912	−2.3	1827	2.3				
19	1907	−1.6	1900	1.3	1841	−1.7	1826	1.1	1917	−1.5	1872	1.5	1917	−2.3	1826	2.1				
20	1904	−1.5	1847	1.2	1873	−1.7	1856	1.0	1859	−1.4	1894	1.4	1867	−2.2	1854	2.1				
21	1824	−1.4	1840	1.1	1889	−1.7			1847	−1.4	1919	1.4	1902	−2.1	1853	2.0				
22	1827	−1.4	1901	1.1	1814	−1.6			1837	−1.3	1922	1.4	1847	−2.0	1878	2.0				
23	1858	−1.4	1908	1.1	1851	−1.6			1884	−1.3	1925	1.3	1849	−2.0	1831	1.9				
24	1884	−1.3	1865	1.0	1864	−1.5			1877	−1.2	1844	1.2	1875	−2.0	1852	1.9				
25	1815	−1.2			1844	−1.4			1888	−1.2	1856	1.2	1837	−2.0	1893	1.8				
26	1852	−1.2			1859	−1.4			1896	−1.2			1907	−1.5	1846	1.7				
27	1860	−1.2			1866	−1.4			1903	−1.2			1897	−1.4	1833	1.5				
28	1881	−1.2			1869	−1.4			1908	−1.2			1836	−1.4	1874	1.5				
29	1853	−1.1			1874	−1.4														
30	1905	−1.0			1886	−1.4														
1927		−1.1				−1.2				−3.2				3.5				−2.4		

TABLE 1.—*Departures from the normal of the mean summer temperatures in the coolest and the warmest summers, respectively, at 25 representative stations in the United States*—Continued

No.	Philadelphia, Pa. (55 years)				Baltimore, Md. (56 years)				Washington, D. C. (56 years)				Lynchburg, Va. (54 years)			
	Cool		Warm		Cool		Warm		Cool		Warm		Cool		Warm	
	Year	Depression	Year	Excess	Year	Depression	Year	Excess	Year	Depression	Year	Excess	Year	Depression	Year	Excess
1	1903	−3.9	1900	3.0	1907	−3.5	1870	5.2	1907	−3.2	1872	3.9	1907	−2.4	1881	3.6
2	1907	−1.7	1901	2.1	1903	−3.3	1872	3.1	1903	−3.0	1876	2.6	1889	−1.9	1900	2.3
3	1884	−1.5	1876	1.8	1891	−3.2	1876	1.8	1886	−2.3	1900	2.2	1903	−1.8	1892	1.6
4	1875	−1.5	1898	1.7	1886	−3.0	1900	1.8	1904	−2.0	1873	2.0	1910	−1.8	1925	1.3
5	1891	−1.4	1892	1.5	1904	−2.3	1925	1.1	1891	−1.9	1874	1.8	1920	−1.8	1878	1.2
6	1883	−1.2	1899	1.4	1889	−2.0	1877	1.1	1889	−1.6	1898	1.8	1886	−1.6	1917	1.2
7	1881	−1.2	1872	1.4	1897	−1.9	1898	0.9	1912	−1.4	1901	1.5	1891	−1.6	1911	1.0
8	1915	−1.2	1887	1.3	1915	−1.9	1901	0.9	1897	−1.3	1892	1.5	1918	−1.4	1914	1.0
9	1902	−1.1	1917	1.0	1913	−1.7	1873	0.9	1884	−1.0	1911	1.5	1915	−1.3	1870	0.9
1927		−2.6				−2.6				−2.9				−3.6		

No.	Jacksonville, Fla. (56 years)				Montgomery, Ala. (55 years)				Memphis, Tenn. (56 years)				New Orleans, La. (56 years)				Galveston, Tex. (57 years)			
	Cool		Warm		Cool		Warm		Cool		Warm		Cool		Warm		Cool		Warm	
	Year	Depression	Year	Excess	Year	Depression	Year	Excess	Year	Depression	Year	Excess	Year	Depression	Year	Excess	Year	Depression	Year	Excess
1	1904	−1.6	1881	2.2	1912	−1.9	1881	2.7	1903	−2.2	1881	3.5	1894	−2.5	1921	4.4	1903	−2.6	1875	3.1
2	1906	−1.4	1876	1.9	1903	−1.8	1902	2.3	1910	−2.2	1925	2.9	1879	−1.8	1919	3.5	1894	−2.4	1881	2.6
3	1920	−1.3	1878	1.6	1910	−1.8	1877	2.1	1915	−2.0	1914	2.6	1892	−1.6	1924	2.6	1904	−1.5	1876	2.3
4	1889	−1.2	1883	1.6	1884	−1.7	1878	1.6	1889	−1.9	1874	2.3	1880	−1.3	1873	2.5	1919	−1.5	1872	2.2
5	1918	−1.1	1897	1.6	1889	−1.6	1914	1.4	1904	−1.8	1921	1.9	1890	−0.9	1881	1.9	1889	−1.0	1871	2.1
6	1919	−1.1	1880	1.3	1923	−1.6	1925	1.3	1917	−1.8	1901	1.8	1904	−0.9	1915	1.9	1920	−1.0	1883	2.0
7	1921	−1.1	1914	1.2	1904	−1.4	1883	1.3	1891	−1.7	1885	1.5	1912	−0.9	1902	1.6	1892	−0.9	1878	2.0
8	1910	−1.0	1885	1.1	1894	−1.4	1875	1.3	1912	−1.7	1871	1.3	1875	−0.8	1878	1.1	1913	−0.9	1885	1.9
9	1884	−0.9	1877	1.0	1920	−1.2	1874	1.1	1920	−1.6	1918	1.3			1914	1.1			1877	1.8
10	1894	−0.9	1900	0.9	1883	−1.1	1876	1.1	1906	−1.5	1896	1.2							1884	1.3
11					1916	−1.1	1897	1.1	1882	1.4	1878	1.1							1896	0.9
12					1917	−1.1	1921	1.1	1877	−1.1	1899	1.1								
13									1892	−1.1	1909	1.1								
14	1927	0.0				−0.2				−2.3						0.8				0.7

No.	Cincinnati, Ohio (56 years)				Indianapolis, Ind. (56 years)				Chicago, Ill. (54 years)				Cheyenne, Wyo. (56 years)			
	Cool		Warm		Cool		Warm		Cool		Warm		Cool		Warm	
	Year	Depression	Year	Excess	Year	Depression	Year	Excess	Year	Depression	Year	Excess	Year	Depression	Year	Excess
1	1915	−3.0	1874	3.3	1915	−4.0	1874	4.6	1875	−4.0	1921	5.3	1915	−5.1	1881	4.9
2	1889	−2.8	1881	3.1	1889	−2.9	1873	3.3	1915	−3.7	1919	3.7	1895	−2.7	1874	3.2
3	1891	−2.7	1901	2.7	1904	−2.7	1872	3.2	1884	−3.6	1911	2.8	1906	−2.6	1873	2.8
4	1921	−2.5	1872	2.3	1903	−2.5	1901	2.9	1891	−3.4	1913	2.7	1904	−2.4	1923	2.5
5	1920	−2.0	1913	2.3	1912	−2.2	1921	2.8	1903	−3.3	1914	2.5	1908	−2.4	1919	2.4
6	1886	−1.9	1914	2.1	1917	−2.2	1871	2.4	1883	−3.0	1870	2.3	1917	−2.1	1871	2.2
7	1903	−1.9	1876	2.1	1920	−1.8	1913	2.1	1889	−2.8	1916	2.2	1872	−1.9	1879	2.2
8	1907	−1.6	1873	2.0	1924	−1.8	1881	2.1	1904	−2.8	1901	2.1	1920	−1.7	1901	1.8
9	1885	−1.5	1877	1.9	1885	−1.8	1914	2.0	1882	−2.5	1874	2.0	1875	−1.5	1922	1.7
10	1910	−1.4	1898	1.7	1902	−1.7	1919	1.9	1902	−2.3	1910	1.9	1891	−1.5	1886	1.5
11	1917	−1.4	1919	1.7	1882	−1.6	1875	1.8	1924	−2.0	1922	1.8	1912	−1.4	1900	1.5
12	1912	−1.3	1871	1.5	1910	−1.4	1887	1.3	1917	−1.8	1880	1.6	1897	−1.2	1909	1.4
13	1875	−1.2	1878	1.5	1877	−1.4	1894	1.3	1892	−1.6	1908	1.4	1907	−1.2	1910	1.2
14	1904	−1.0	1887	1.5	1891	−1.3	1895	1.3	1873	−1.6	1923	1.4	1903	−1.1		
15	1882	−0.8	1900	1.4	1884	−1.0	1899	1.3	1885	−1.6	1894	1.3				
16			1925	1.4					1888	−0.9	1899	1.3				
17	1927	−3.1				−3.9				−3.9				−2.5		

No.	Denver, Colo. (55 years)				Santa Fe N. Mex. (54 years)				Salt Lake City, Utah (53 years)				Boise, Idaho (38 years)			
	Cool		Warm		Cool		Warm		Cool		Warm		Cool		Warm	
	Year	Depression	Year	Excess	Year	Depression	Year	Excess	Year	Depression	Year	Excess	Year	Depression	Year	Excess
1	1915	−4.0	1881	3.9	1895	−2.5	1874	2.5	1907	−4.0	1919	4.6	1907	−3.2	1922	3.2
2	1887	−3.6	1874	3.4	1908	−2.1	1879	2.0	1908	−3.4	1887	3.0	1916	−2.6	1878	2.7
3	1904	−3.0	1892	2.9	1906	−2.0	1922	2.0	1891	−2.7	1922	2.7	1881	−2.6	1919	1.9
4	1885	−2.9	1901	2.6	1907	−2.0	1881	1.8	1899	−2.2	1889	2.4	1912	−2.4	1921	1.9
5	1891	−2.6	1922	2.3	1905	−1.9	1902	1.8	1895	−2.1	1878	2.0	1902	−2.1	1889	1.5
6	1880	−2.5	1878	1.9	1921	−1.8	1889	1.6	1906	−2.1	1910	1.9	1880	−2.0	1918	1.4
7	1906	−2.3	1919	1.9	1894	−1.6	1918	1.4	1880	−1.6	1918	1.9	1899	−2.0	1926	1.4
8	1912	−2.3	1879	1.7	1911	−1.5	1917	1.3	1897	−1.6	1924	1.9	1908	−1.4	1882	1.0
9	1908	−2.1	1900	1.6	1897	−1.4	1902	1.3	1894	−1.3	1921	1.8	1887	−1.2	1903	0.8
10	1897	−1.6	1873	1.4	1915	−1.4	1878	1.1	1904	−1.2	1886	1.8	1911	−0.7		
11	1898	−1.5	1924	1.3	1920	−1.3	1888	1.1	1885	−1.1	1883	1.7				
12	1920	−1.2	1910	1.2	1904	−1.2	1924	1.0			1900	1.6				
13	1883	−1.1	1918	1.2	1912	−1.2	1910	0.8			1881	1.3				
14	1923	−1.0	1893	0.9							1901	1.1				
15																
16																
17																
	1927	−2.3						0.1				0.8				0.7

No.	Portland, Oreg. (54 years)				San Francisco, Calif. (56 years)				San Diego, Calif. (57 years)			
	Cool		Warm		Cool		Warm		Cool		Warm	
	Year	Depression	Year	Excess	Year	Depression	Year	Excess	Year	Depression	Year	Excess
1	1899	−3.0	1926	4.1	1911	−2.7	1888	2.4	1879	−3.3	1871	3.3
2	1881	−2.6	1918	2.0	1901	−2.5	1925	2.3	1899	−2.8	1883	2.0
3	1893	−2.6	1889	1.7	1910	−2.4	1891	1.8	1894	−2.2	1875	1.9
4	1880	−2.3	1875	1.6	1887	−2.2	1926	1.7	1916	−2.1	1885	1.8
5	1901	−2.3	1915	1.6	1893	−2.1	1921	1.6	1880	−2.0	1891	1.8
6	1910	−1.6	1917	1.6	1908	−2.0	1877	1.5	1902	−1.8	1918	1.8
7	1909	−1.5	1922	1.6	1899	−1.7	1913	1.5	1892	−1.7	1925	1.7
8	1887	−1.0	1923	1.6	1871	−1.6	1922	1.5	1908	−1.6	1877	1.6
9	1890	−1.0	1925	1.6	1909	−1.6	1890	1.4	1892	−1.7	1926	1.5
10	1900	−1.0	1906	1.4	1894	−1.5	1915	1.4	1905	−1.5	1888	1.4
11	1895	−1.0	1888	1.1	1914	−1.4	1923	1.2	1895	−1.3	1876	1.3
12	1902	−0.9	1920	1.1	1880	−1.3	1880	1.1	1914	−1.3	1884	1.3
13			1924	1.1	1898	−1.3			1911	−1.2	1919	1.2
14			1886	1.0	1882	−1.0			1901	−1.1	1882	1.0
15			1913	1.0			1879	1.0	1912	−1.1	1922	1.0
16			1891	0.9					1909	−1.1		
17									1910	−1.0		
	1927			2.1				2.0				1.0

COOL SUMMERS

The cool summer of 1816.—Information as to the summer of 1816 is of two sorts: First, thermometric observations made in New England and southeastern Pennsylvania, together with references to the unusual weather of that year that are found in authentic historical documents of the time; and second, the accounts, mostly by space writers, that have appeared in recent years in which the sensational aspect of the summer in question is emphasized and statements are made that can not now be proved or disproved.

A number of the details of the cool summer of 1816 that have appeared in the public prints are grossly exaggerated.

During the period of years, 1811–1817, the most remarkable depression of temperature in the summer months occurred in New England. There is not the slightest justification for claiming or assuming that the summer temperatures generally throughout the United States were unduly low. The years 1812 and 1816 were the two outstanding examples of great cooling in the summer months in New England.

An account of the cool summer of 1816, based mainly on the original observations made in Williamstown, Mass., is given by Milham (1). This is the most detailed and complete account of that unusual summer that has yet appeared in print.

Cool summers, Table. 1.—The table includes the most reliable and homogeneous pre-Weather Bureau temperature records available, viz, those of New Haven, Conn., 1813–1912, New Bedford, Mass. 1813–1912. The records of these two stations are unique in that both contain the record of the cool summer of 1816 as well as those of subsequent abnormal summer temperatures. The two western, or rather interior-valley stations of St. Paul Minn., and St. Louis, Mo., the first having a record that dates back to 1820 and the second to 1837, are the only ones in the interior that are available in this study. For New England the summer of 1816 was the coolest in more than 100 years, and this statement is confirmed by the evidence of eight other New England stations having much shorter records. All of these stations except Salem, Mass., unite in ascribing to 1816 the coolest summer in the nineteenth century; further search, however, discloses the fact that the summer of 1812 at Salem, Mass., was cooler than the 1816 summer at the same station (2). The group of years 1811–1817 in New England was remarkable in that low summer temperatures were experienced throughout. The record at Salem extends from 1786 to 1828; during this period the year 1812 was decidedly the coolest and the same is true of Cambridge, Mass., a station having a record comparable, both as to length and period of years, with that of Salem.

There are no instrumental or other reliable records that support the view that the 1816 summer was a cool one generally throughout the United States; indeed, if we are to believe the editorial that appeared in the Boston Recorder of August 7, 1816, the contrary may have been the case. The editorial comment follows:

> In relation to the season, accounts from all parts of the country present an agreeable reversal of the gloomy reports which were made a few weeks since. Fruits of every description will be abundant. All kinds of grain except corn are more promising than in ordinary seasons.

The data of Table 1 should be interpreted with the knowledge that oscillations of temperature are greatest in the interior of continents and in relatively high latitudes. St. Paul, Minn., is a good example of the large variations that occur in the interior as compared with a coastal station. The amplitude of the oscillation at that station in the 107 years of record was 11.1°, or from 5.9° below to 5.2° above the normal. At the New Haven station, near the ocean, the amplitude, including the cool summer of 1816, was but 9°, from 4.2° below to 4.8° above.

The second coolest summer.—At the long-record station of New Haven the second coolest summer occurred in 1903, 87 years later than the first, and the abnormality was within three-tenths of a degree of that of 1816. At New Bedford the summers of 1836 and 1903 were equal in coolness, but since 1836 as a whole was a very cold year, the summer of that year is given second place in relative rank.

The lowering of the summer temperature of 1903 was due, in the main, to the exceptionally low temperature of June of that year over a rather large area in the United States, viz, from southern New England southwestward to eastern New Mexico, southward to the Gulf of Mexico, and northward as far as Iowa and the lower Lake region.

In order to show graphically the relative rank of the three largest negative abnormalities at the 25 stations, I have charted them in Figure 1. Comment on that figure is unnecessary.

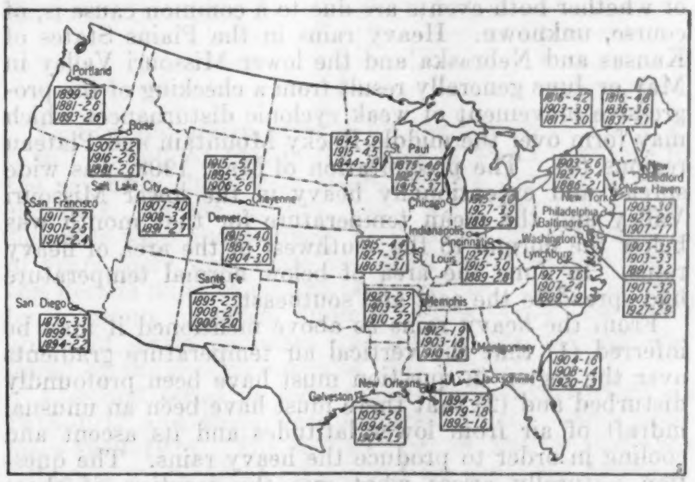

FIG. 1.

The cool summer of 1927.—The abnormality of the summer of 1927 is given for each station at the bottom of Table 1. The depression of temperature in this summer was due largely to low maxima and not to pronounced low minima.

As shown in Figure 1, it was the coolest summer in fifty-odd years at Lynchburg, Va., Memphis, Tenn., and Cincinnati, Ohio, and the second coolest at New York City, Philadelphia, Chicago, St. Louis, and Indianapolis; it was the third coolest at Washington, D. C.

At the 100-year record stations (New Haven and New Bedford) its relative rank was No. 30 and No. 32, respectively. That is to say, at New Haven there have been 29 summers since 1816 that were cooler than the summer of 1927. At New Bedford the number was 31.

Sequence of cool summers.—In order to see whether there is any massing of cool summers at periodic intervals, I have arranged the number of occurrences of first, second, and third coolest summers chronologically and present the results in Table 2. These data are defective for the period prior to the early seventies because of lack of sufficient records.

In the last fifty-odd years four summers of exceptional coolness, 1903, 1907, 1915, and 1927, have occurred. Comparing these summers it may be noticed that there is little to choose from as to which was the most conspicuous as to the depression of the temperature. Considering the length of the time the low temperature prevailed and the area affected and the minimum temperature recorded, 1915 should be given first place. Each month of that summer, including May and in a less degree September, was abnormally cool.

The greatest depression of the temperature in the summer of 1907 was in June following an exceptionally cool April and May (3).[1] The cool summer of that year may therefore be considered as a holdover effect from the cold spring immediately preceding.

The remaining three summers, 1903, 1915, and 1927, have several features in common, the most striking being the fact that each of them was preceded either in May or June by flood-producing rains in the lower Missouri Valley and adjacent territory. It may also be pointed out that the interval between these cool summers is exactly 12 years, and if we go back another 12 years to 1891 we shall find that the mean July temperature of that year was the lowest of record up to that time in a large part of the country. The flood-producing rains were, however, absent to a great extent. Whether the heavy rains are the primary cause of the cool summers or whether both events are due to a common cause is, of course, unknown. Heavy rains in the Plains States of Kansas and Nebraska and the lower Missouri Valley in May or June generally result from a checking of the progressive movement of weak cyclonic disturbances which may form over the middle Rocky Mountain and Plateau regions (4). The precipitation of May, 1903, was wide spread and exceptionally heavy in the lower Missouri Valley and the mean temperature for that month was below the normal to the southwest of the area of heavy rains. In June the area of below normal temperature had spread to the east and southeast.

From the heavy rains as above mentioned it may be inferred (1) that the vertical air temperature gradients over the region in question must have been profoundly disturbed and (2) that there must have been an unusual indraft of air from lower latitudes and its ascent and cooling in order to produce the heavy rains. The question naturally arises what was the reaction of these events upon the subsequent weather in eastern United States? There is always present the tendency to invoke the aid of cosmic causes in the explanation of terrestrial weather. In this particular year there is some ground for such action; it may be remembered that the intensity of solar radiation diminished in 1902 and 1903 (5). In February and March, 1903 a pronounced minimum in the temperature of the surface waters of the North Atlantic was observed (6). The suggestion was made that the minimum thus observed may have been due to the transportation of cold water southward by the Labrador current, but the authors were unable to determine for a certainty whether the cooling was produced by the transportation of cold water or not.

The cool summer of 1915.—The 1915 depression of temperature was unlike those of both 1903 and 1927 in that it was practically continuous from May to August, both inclusive. The locus of greatest cooling in May extended from the great valley of California across the Rocky Mountains, the Plains States to the Lake region and the lower St. Lawrence Valley. In June the entire United States, except a narrow strip along the Gulf coast and from Texas to southern California and along the Pacific was under the influence of the cooling agent. In July the conditions were practically unchanged and in August the greatest depression of the temperature (6°) was confined to the lower Missouri Valley.

An examination of the meteorological records of Canada and Alaska seems to indicate, paradoxical as it may seem, that the great depression of temperature in the United States and to a less extent in Canada had its beginnings in the excess warmth of the spring of 1915 in Alaska and Canada. April, 1915, was unduly warm, particularly in Saskatchewan, where the daily excess of temperature for the month was 12°. The high temperature of that month extended southward and included most of the United States.

In the succeeding month a reversal came, due largely to the origin of four vigorous anticyclones in close proximity to the western shore of Hudson Bay. These formations spread to the southward, carrying with them great bodies of dry cold air from the north and northeast, the effect of which apparently endured until the end of August. The locus of greatest warmth in April was in Saskatchewan, in May it was to the westward near the Pacific where it remained during June and moved slightly to the northeast in July; in August it covered the Mackenzie Basin and had encroached on United States territory to the south.

The locus of the greatest negative departures in May was close to the northern border of the United States, in June it covered the upper Missouri Valley and Wyoming, and in July it had spread slightly to the northeast; in August it was centered over the middle Mississippi and lower Missouri Valleys and wholly within the United States.

During the continuance of the cool weather in the United States and Canada, temperature in Alaska was continuously above the normal and there was a definite spread of the warmer weather southeastward in August. I am therefore inclined to reject the idea that a flow of polar air equatorward was the cause of the low temperature in the summer of 1915 unless polar air be defined as having its origin in latitude 55°–65° N.

In Europe and Asia that summer was also cool over very considerable areas and there were two projections of cool weather equatorward, the first over northwestern Europe and the second over central and southeastern Siberia toward but not including Japan.

The first half of 1915 was characterized by large fluctuations of pressure from the normal in various parts

[1] Cf. Cold Spring of 1907, A. J. Henry, Mo. Wea. Rev. 35:223-25.

of the Northern Hemisphere. For the benefit of those who may wish to speculate upon the relation of any one of these fluctuations to the low temperature of the summer of 1915, the table below has been prepared. The data are from Reseau Mondial, 1915.

Year and month	Deviation	Place
1915		
	mb	
January	−13.4	Dawson, Yukon Territory.
	−11.1	Dutch Harbor, Aleutian Islands.
	−15.1	Budapest, Hungary.
	−15.1	Potsdam, Germany.
	+10.7	Malye Karmakouly, Nova Zembla.
	+14.1	Verkhoiansk, Siberia.
February	−14.1	Valencia, British Isles.
	−12.1	Aberdeen, Scotland.
	+9.7	Perm, Union of Socialistic Soviet Republics.
	+8.9	Ekaterineburg, Union of Socialistic Soviet Republics.
March	−16.1	St. Johns, Newfoundland.
	−15.6	Sable Island, Atlantic Ocean.
	−12.3	Horta, Azores.
	+12.8	Angmagsalik, Greenland.
	+12.0	Upernavik, Greenland.
	+8.0	Okhotsk, Siberia.
April	−10.5	Dawson, Yukon Territory.
	−7.0	Dutch Harbor, Aleutian Islands.
	−10.0	Berufjord, Iceland.
	−7.9	Angmagsalik, Greenland.
	+7.6	Valencia, British Isles.
	+5.4	Horta, Azores.
May	−8.2	St. Johns, Newfoundland.
	−4.5	Horta, Azores.
	−4.8	Barkerville, British Columbia.
	−4.7	Prince Rupert, British Columbia.
	−5.7	Vardo, Norway.
	−4.1	Kola, Union of Socialistic Soviet Republics.
	+5.8	Thorshavn, Faroe Islands.
	+5.8	Aberdeen, Scotland.
	+6.4	Nome, Alaska.
	+3.8	Dutch Harbor, Aleutian Islands.
	+6.5	Petropavlovsk Phare, Kamchatka.
	+4.4	Nikolaevsk-sur-Amour, Siberia.

The record of the 1927 cool summer is complete, month by month, with the issue of this number of the REVIEW. The heavy rains and resulting floods of the early months of the year need not be recounted, but it is to be remembered that the effect of the rains and floods on agriculture was equal to, if not greater than, that of deficient temperature in June and August.

WARM SUMMERS

In the early part of the nineteenth century there were rather violent temperature fluctuations, cold years 1811 to 1817, and again in 1835–1837; warm years in the twenties and early thirties; thus at New Bedford the warmest summer in 100 years was in 1825, while at New Haven it was later, in 1876. Table 2 shows a group of warm summers in the seventies, extending into and apparently reaching a peak in 1881—a year with the greatest number of stations showing warm summers; 1874 comes second in this respect, and finally beginning with 1919, another series of warm summers set in but it was less extensive than the series of 1874–1881.

It is a rather common belief that any extreme in temperature or other meteorological element is more apt to be followed by one of an opposite character than by one of like character, and this tendency is well illustrated in several of the long series of records here presented, although little is found to encourage the belief that this tendency can be used in seasonal forecasting.

TABLE 2.—*Order of magnitude of cool summers and warm summers, respectively, at 25 stations in the United States*

[No. 1 stands for the absolute coolest, or warmest at the number of stations given in the table; No. 2 the next and so on]

Year	Cool			Year	Warm		
	No. 1	No. 2	No. 3		No. 1	No. 2	No. 3
1816	2			1821		1	
1817			1	1825	1		
1836		1		1830	1		
1837			1	1831		2	
1842	1			1837		1	
1844			1	1870	1		
1863		1		1872	1	1	2
1875	1	1	1	1873		1	1
1879	1	1		1874	3	2	
1881		1		1875	1		
1884			2	1876	1	2	3
1886		1	1	1877			2
1887		1		1878			1
1889		3		1879	1	1	
1891			3	1881	6	2	
1892			1	1887		1	
1893			2	1888		1	
1894	1		1	1889			1
1895	1	1		1891	1		
1897			1	1892			2
1899	1	1		1894			2
1903	4	4	1	1899		1	
1904	1		3	1900	1	2	1
1906			2	1901	1	1	1
1907	4	1		1902		1	
1908		3		1906			1
1910		2	1	1911			1
1911	1			1914			2
1912	1			1918		1	
1915	5	2	1	1919	1	2	2
1920			1	1921	2		
				1922			1
				1925	1	1	
				1926	1		1

Testing the above precept by the figures in Table 2, it will be noticed that in the series of warm summers in the seventies there were interspersed a number of cool summers. In the eighties, after 1881, warm and cool summers were about evenly divided; in the next decade of years there were more cool than warm summers and this decade must be classed as a cool one, it was followed by a group of warm summers—1899–1901—and this group of warm summers was almost immediately followed by the cool summers of 1903 and 1907.

A second series of cool summers was experienced in 1915–1917 and these were followed by the warm summers 1919–1926. The cool summer of 1927 is therefore following a precedent established by centuries of observations.

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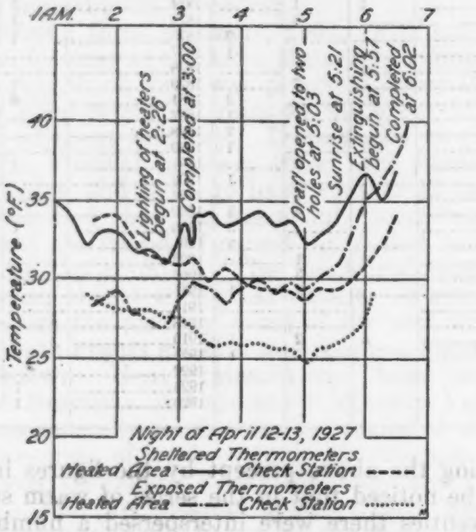
THE PROTECTION OF STRAWBERRIES FROM FROST THROUGH ARTIFICIAL HEATING

By ALBERT W. COOK

The strawberry is one of the best-paying soft fruit crops grown in the southern Yakima Valley of Washington. However, the financial success of the strawberry industry is dependent upon several factors, and among these, damaging late spring frosts play an important part. The annual loss to the strawberry crop is not constant, but varies from year to year. Some years there may be no frost, while in others a severe frost may kill the early bloom and seriously curtail the output of fruit. The continuance of the strawberry as one of the major soft fruit crops is dependent upon the solution of the problem of late spring frosts. Tests were undertaken by the Weather Bureau fruit-frost service to ascertain the possibility and practicability of protecting strawberry buds and blossoms from damage by frost by methods of artificial heating.



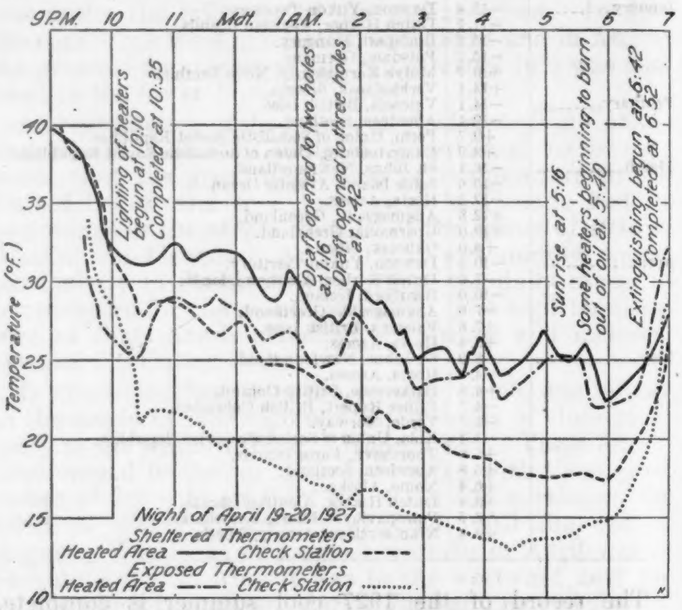
NOTES FOR FIG. 1—NIGHT OF APRIL 12–13, 1927

P. m.
5:00 Dew point, 29° F. Relative humidity, 29 per cent. Temperature, 61.5° F. Wind north 2. m. p. h. Sky clear 1 Ci-?
A. m.
1:48 Dew point, 26° F. Relative humidity, 65 per cent.
2:20 Frost forming on shelter top in patch.
2:26 Lighting of heaters begun.
3:00 Lighting completed.
3:02 Frost melting on shelter in heated area. Beginning to melt on plants.
3:12 Drafts cut down to slightly less than one hole. Frost melting on plants 9 feet from shelter.
3:18 Frost heavy on shelter at check station. Alfalfa adjoining strawberry patch heavy with frost. Very light southerly drift.
3:20 Some frost on shelter in heated area. Dew on exposed thermometer in heated area. Some light frost on plants in heated area about 7 feet from heaters.
3:34 No appreciable drift. Flames rising vertically.
3:50 Westerly drift—about 4 miles per hour.
4:10 Ground dry 8½ feet from heaters. No frost 10 feet from heaters.
4:15 Frost on top of shelter in heated area. Westerly drift—4 m. p. h.
4:50 Smoke rising vertically.
4:56 Light frost showing about 8 feet from heaters.
5:03 Draft opened to two holes.
5:21 Sunrise.
5:22 Frost showing on part of leaves about 7½ feet from heaters.
5:57 Extinguishing of heaters begun.
6:04 Extinguishing of heaters completed.

No frost on alfalfa 6 feet south of south row of heaters and 7 feet north of north row of heaters.

Blossoms marked before heating was necessary in all parts of the patch showed no injury upon examination following day.

It was deemed advisable to conduct the investigation, as far as practicable, in a typical patch fully representing the various circumstances existing and under natural frost conditions. The tract selected for the test was located about one-fourth mile south of Kennewick. It was a little less than 1 acre in size, sloped gently toward the northeast, and was planted to Clark Seedling strawberries 4 years old. It was equipped with double-stack 3-gallon, oil-burning heaters placed 20 feet apart on the square. (See fig. 4.) The outside row of heaters was placed 5 feet inside of the outside edge of the patch, and no border row was used. The heaters were mounted upon tripods (fashioned of heavy wire twisted to form the legs, thus making at the top a rest upon which to set the heater) so that the top of the heater stack was 30 inches above the surface of the plants. Ninety-six heaters were used, burning 24° gravity crude oil.



NOTES FOR FIG. 2—NIGHT OF APRIL 19–20, 1927

P. m.
5:00 Dew point, 15° F. Relative humidity, 24 per cent. Temperature, 49.2° F. Wind northwest 14 m. p. h. Sky partly cloudy 5 StCu-West.
9:00 Wind from northwest but decreasing in velocity.
9:30 Wind decreasing; temperature beginning to fall.
9:45 Very little wind; decided fall in temperature.
10:10 Lighting of heaters begun, alternate heaters.
10:25 Second lighting, balance of heaters.
10:35 Lighting of heaters completed.
11:00 Decided westerly drift of about 4 miles per hour.
11:30 Dew point, 20° F. Relative humidity, 70 per cent.
11:55 Refueling of heaters begun; continued the balance of the night.
Mdt.
12:00 Westerly drift still continues.
A. m.
12:27 Ground showing crust outside heated area.
1:16 Draft opened to two holes.
1:42 Draft opened to three holes.
2:00 Ground crusting in irrigation furrows. Light wind from southwest blowing the smoke along the ground.
2:06 Wind shifting to west and northwest (4-6 miles per hour). Frost showing on alfalfa in field adjoining patch.
2:15 Wind shifting to east; no decrease in velocity.
3:57 Ground crusted hard outside heated area; heavy frost on shelter in check station; ice in irrigation ditches about 6 feet from heaters.
5:00 Frost showing about 7½ feet from heaters; ground hard about shelter but soft within 7½ feet of heaters.
5:16 Sunrise.
5:40 Some heaters beginning to burn out of oil.
6:42 Extinguishing of heaters begun.
6:52 Extinguishing of heaters completed.

Patch about 20 per cent in full bloom. Most conservative estimate placed damage at 20 per cent of bloom with bud injury negligible.

Lowest temperatures reached after sunrise when heaters were burning out of oil. Damaged buds no doubt frozen at that time.

A temperature station was located in the exact center of the plot, and another 300 feet due south of this and outside the heated area, for the purpose of furnishing a check on the outside temperature. Each station was equipped with a minimum thermometer and a 29-hour thermograph in a fruit-region instrument shelter. The shelter was set directly upon the surface of the plants and the thermometer bulb was 10 inches above the ground. A horizontal, registering, minimum thermometer with

clear liquid was placed upon the surface of the plants with its bulb exposed to the sky and used to measure the effect of the radiant heat upon the plants. The distance from the thermometer bulbs to the nearest heater was 13 feet 8 inches, the greatest possible distance. The instrumental equipment at the check station was an exact duplicate of that used in the heated area.

The stations were so located as to give the temperature in the heated area, and, as determined from that at the check station, the temperature which would have occurred had there been no lighting of heaters. This made possible the measurement of the increase in temperature brought about by the firing of the heaters by comparing the temperature in the heated area with that recorded simultaneously at the check station.

The experiment was carried on under natural frost conditions, and the heaters were lighted only when it was necessary to protect the buds from injury, namely, on the nights of April 12-13, 19-20, and 20-21.

Temperature data are shown graphically in Figures 1, 2, and 3 on nights when firing was done.

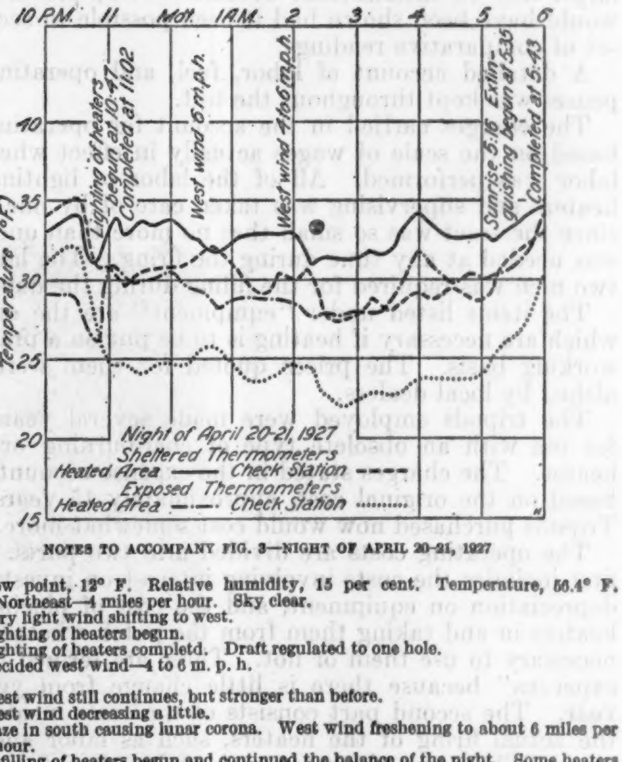
The lowest temperature ever recorded during the strawberry season occurred this year.

About 10 per cent of the buds were in full bloom on the night of April 12-13, and at the time of the severe freeze, April 19-20, about 20 per cent of the buds were in full bloom.

On the night of April 12-13 the heaters were placed directly upon the plants, with the top of the stack about 22 inches above the surface of the plants. The draft was opened to one hole, except for the last hour in the morning, when it was opened to two holes. Examination of the chart for this night, Figure 1, shows the maximum rise in temperature occurred between 5:45 and 6 a. m., when the increase in temperature was 6.1° F. inside the instrument shelter and 7.7° F. on the surface of the plants, as shown by direct comparison of the readings after allowing for the average differences before firing of the heaters was begun.

Computations involving all of the readings taken while the heaters were burning (first reading after lighting of heaters to the last one before extinguishing was completed) show the average rise in temperature inside the instrument shelter to be 3.5° F. and on the surface of the plants 4.7° F. The influence of the direct radiation from the heaters on the temperature at the surface of the plants is shown by comparing the exposed thermometer readings. This can also be shown by comparing the difference between the sheltered and exposed thermometers in the heated area before the heaters were lighted with the difference while the heaters were burning. The average difference between the readings of the sheltered and the exposed thermometers, as indicated by a set of comparative readings taken on the night of April 13-14, when no heaters were lighted, and before lighting on the night of April 12-13, was 4.1° F. The average difference after the lighting of the heaters, night of April 12-13, was 3.9° F., making a rise of 0.2° F., due to the heating. Adding this to the rise of 3.5° F. shown by the sheltered thermometer indicates an average effective increase in temperature at the surface of the plants of 3.7° F. The maximum effective rise in temperature was 8.3° F. at the surface of the plants.

On the night of April 19-20 the heaters were mounted upon metal tripods, so that the top of the stack was 30 inches above the surface of the plants. It was found necessary to burn the heaters with two to three draft holes open the last half of the night to secure adequate protection. From 1:42 a. m. until morning the heaters were operated at maximum capacity. The maximum increase in temperature inside the shelter was 9.0° F. at 4:58 a. m., shortly before sunrise. The average increase in temperature inside the shelter was 5.1° F. The maximum effective rise in temperature on the surface of the plants, including the rise due to direct radiation from the heaters, was 12.1° F., and the average effective increase in temperature was 8.4° F. by direct comparison of the readings from the exposed thermometers in the heated area and at the check station. The effective rise in temperature at the surface of the plants, as shown by comparing the difference between the exposed and sheltered thermometer readings before and after lighting of the heaters, was 11.7° F., and the average effective rise in temperature by this method was 7.2° F.



NOTES TO ACCOMPANY FIG. 3—NIGHT OF APRIL 20-21, 1927

P. m.
5:00 Dew point, 12° F. Relative humidity, 15 per cent. Temperature, 56.4° F. Northeast—4 miles per hour. Sky clear.
9:00 Very light wind shifting to west.
10:47 Lighting of heaters begun.
11:02 Lighting of heaters completd. Draft regulated to one hole.
11:03 Decided west wind—4 to 6 m. p. h.
A. m.
12:30 West wind still continues, but stronger than before.
1:00 West wind decreasing a little.
2:00 Haze in south causing lunar corona. West wind freshening to about 6 miles per hour.
2:10 Refilling of heaters begun and continued the balance of the night. Some heaters being filled all of the time.
3:00 West wind decreasing.
4:02 Few cirrus clouds on horizon to south and northeast. Still more of a decrease in the wind.
5:16 Sunrise.
5:30 Sky cloudy with cirrus.
5:35 Extinguishing of heaters begun.
5:43 Extinguishing of heaters completed.

Patch in about the same condition as on previous night as to bloom, etc. No injury noted upon inspection later in the day.

The heaters remained upon the tripods on the night of April 20-21. It was not found necessary to open the drafts more than one hole at any time during the night. A maximum increase of 5.1° F. in the shelter and 8.1° F. on the surface of the plants was secured. The average increase in temperature was 3.0° F. in the shelter and 5.2° F. on the surface of the plants as shown by direct comparison. The maximum effective rise in temperature on the surface of the plants by comparsion of the exposed and sheltered thermometers in the heated area before and after lighting of the heaters was 6.8° F., and the average effective rise was 3.9° F. by this method.

The apparent discrepancy in the values of the effective increase of temperature at the surface of the plants when computed by the two methods is, in all probability, due

to the incorrect assumption that the average differences between the readings of the several thermometers when no heaters were burning were the same at all times. On the night of April 13–14, when the set of comparative readings used as the basis for the differences was taken, there was no appreciable air movement; while on the nights of April 19–20 and 20–21 there was considerable wind, at times reaching a velocity of 4 to 6 miles per hour. This air movement would surely make some difference in the readings of the thermometers. Because of a moderate to fresh wind which blew during the early part of the evening on the last two nights, comparative readings could not be taken before it was necessary to light the heaters. The temperature dropped rapidly following a cessation of the wind. It is not unlikely that the range of differences on the nights of April 19–20 and 20–21 was large, due to intermittent breezes. This, presumably, would have been shown had it been possible to secure a set of comparative readings.

A detailed account of labor, fuel, and operating expenses was kept throughout the test.

The charges carried in the account for operating are based on the scale of wages actually in effect when the labor was performed. All of the labor of lighting the heaters and supervising was taken care of by one man, since the tract was so small that no more than one man was needed at any time during the firing. The labor of two men was required for the filling during the day.

The items listed under "equipment" are the articles which are necessary if heating is to be put on a practical working basis. The prices quoted for them were furnished by local dealers.

The tripods employed were made several years ago for use with an obsolete type of coal-burning orchard heater. The charges stated in the expense account were based on the original cost, approximately 15 years ago. Tripods purchased now would cost somewhat more.

The operating costs are divided into two parts. The first includes the costs involving interest on investment, depreciation on equipment, and the cost of placing the heaters in and taking them from the patch whether it is necessary to use them or not. These are termed "fixed expenses" because there is little change from year to year. The second part consists of the costs incident to the actual firing of the heaters, such as labor and fuel costs. These are given for each night when firing was necessary and are carried to considerable detail.

The equipment used was that required for 1 acre. Hence the expenses listed represent the cost of heating a tract 1 acre in extent. However, the test plot was slightly less than 1 acre in size.

VARIABLE OPERATING EXPENSES

[Night of April 12-13, 1927]

Fuel consumed, 173 gallons, at $0.075 per gallon	$12.98
Hauling fuel to the patch	.73
Refilling heaters after firing	1.60
Firing labor	5.00
Lighting mixture	.22
Total expenses for the night	20.53

Burning time: One draft hole open 2 hours 38 minutes; two draft holes open 1 hour; total burning time, 3 hours 38 minutes.

[Night of April 19-20, 1927]

Fuel consumed, 590 gallons, at $0.075 per gallon	$44.25
Hauling fuel to patch	2.48
Refilling after firing	1.60
Firing labor	5.00
Labor for refilling during the night [1]	4.00
Lighting mixture	.22
Total expenses for the night	57.55

Burning time: One draft hole open 3 hours 6 minutes; two draft holes open 0 hour 26 minutes; three draft holes open 5 hours 10 minutes; total burning time, 8 hours 42 minutes.

[Night of April 20-21, 1927]

Fuel consumed, 300 gallons, at $0.075 per gallon	$22.50
Hauling fuel to patch	1.26
Refilling after firing	1.60
Firing labor	5.00
Labor for refilling during the night [1]	3.00
Lighting mixture	.22
Total expenses for the night	33.58

Burning time: One draft hole open 7 hours.

Total variable operating expenses for the season for 1 acre. $111.66

EQUIPMENT INVESTMENT

1 500-gallon tank at $45.50	$45.50
1 wagon at $65	65.00
2 buckets at $1.35	2.70
96 heaters at $1.38	132.48
96 tripods at $0.05	4.80
1 lighting torch at $3.75	3.75
2 thermometers at $3.75	7.50
Total investment	261.73
288 gallons of oil at $0.075 per gallon carried over	21.60
Hauling fuel to ranch	1.21
Total	22.81

FIXED OPERATING EXPENSES

Interest:	
6 per cent on $22.81 for 10 months	$1.14
6 per cent on $261.73, original investment	15.70
	16.84
Depreciation on equipment:	
Storage tank, 5 per cent on $45.50	2.28
Wagon, 10 per cent on $65	6.50
Torch, 20 per cent on $3.75	.75
Buckets, 20 per cent on $2.70	.54
Heaters, 10 per cent on $132.48	13.25
Thermometers, 5 per cent on $7.50	.38
	23.70
Seasonal operation:	
Setting heaters in patch and filling	2.60
Emptying and taking in heaters	3.40
	6.00
Total fixed operating expenses	46.54
Total variable operating expenses	111.66
Total expenses for the season for one acre	158.20

The Kennewick-Richland section of the Yakima Valley is the earliest fruit-growing district of the Pacific North-

[1] The labor charge for refueling the heaters during the burning period could have been materially reduced, or even avoided entirely, if larger capacity heaters had been used. In effect, the use of larger heaters would have reduced the operating expense on the test plot by about 6 per cent.

FIG. 4.—Type of orchard heater used in strawberry protection experiment in place on tripod

FIG. 5.—Instrument shelter in protected area

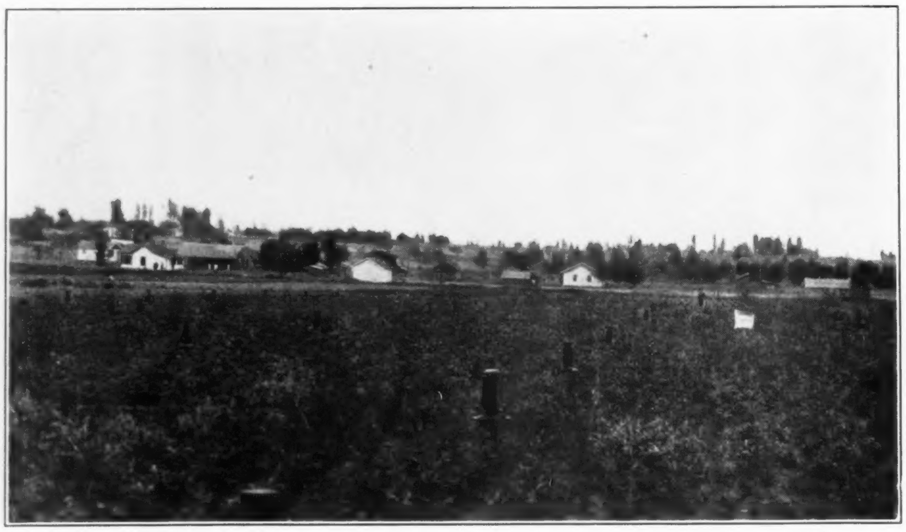


FIG. 6.—General view of protected strawberry acreage, with heaters in position ready for firing

west. The strawberry crop is harvested early and commands a high price, as is evidenced by the following table of returns to the growers for the 1927 season, taken from a published statement by the Kennewick branch of the Yakima Fruit Growers Association:

	Per crate
May 19 to 21	\$6. 20 to \$5. 80
May 22 to 25	4. 80 to 4. 40
May 26 to 28	4. 53 to 4. 13
May 29 to June 1	4. 23 to 3. 83
June 2 to 4	4. 30 to 3. 90
June 5 to 8	4. 15 to 3. 75

The prices quoted in the above table are representative of the returns to the growers for early strawberries during the past few years. These prices will undoubtedly be paid in the future, as long as the strawberries can be placed upon the market in advance of those from competing sections as has been done in the past when no injury resulted from frost.

In the event of a serious frost, enough late bloom may be uninjured to mature a fair crop (from 20 to 50 per cent of a normal yield). However, the berries are usually small and of poor quality and are placed upon a declining market in direct competition with strawberries from other districts more favorably located with respect to the markets. With the prices which have prevailed for the early berries for the past few years and a strawberry bed producing 200 crates or more per acre, it is readily seen that considerable expense would be justified in saving the early bloom.

Although berries have been grown on the test plot or adjoining ground for four years, the first crate to be shipped from the Kennewick-Richland district was never picked from this tract until this year. This would seem to bear out the contention that the early bloom was killed in the unprotected patches this year.

The following table gives the dates on which the first crate of berries was picked in the Kennewick-Richland district, and the date on which the first berries were picked on the patch used for the test:

	Test plot	Kennewick-Richland		Test plot	Kennewick-Richland
1924	May 10	May 6	1926	Apr. 30	Apr. 24
1925	May 5	May 2	1927	May 14	May 19

The length of time during which firing of the heaters was necessary on the nights of April 19–20 and 20–21 was somewhat longer than that usually experienced in the Yakima Valley, and the temperatures were the lowest ever recorded during the stawberry blossom period. If a grower intends to insure a crop every year, it is essential that he be prepared to meet the worst conditions possible, both as to temperature and length of firing period.

The results of this experiment prove conclusively that strawberries and other low-lying ground crops can be protected from frost injury by methods of artificial heating. The chief consideration is the cost of the heating operation in comparison with the net returns from the crop.

In order to render heating a paying proposition, it is necessary to have a well-kept, full-producing bed. The test plot was not such a patch. A large number of the plants were winterkilled in December, 1924, and new runners set out by the remaining plants in following years were sufficient to cover only about 60 per cent of the available ground. This fact should be borne in mind when one is considering the yield from the heated area. One hundred and forty-two standard 24-pint crates were harvested from the test plot. Assuming that only 60 per cent of the available ground produced berries, the yield per acre was 237 crates. The annual yield when no injury results from frost varies from 200 to 350 crates per acre.

It was not possible to secure comparative records of yields between the heated area and an unheated area, because all of the bed was equipped with heating apparatus. However, yield records from the patch of Mr. G. W. Krohling, of Richland, are available. Mr. Krohling used the same type of heater as that used on the test plot on one half of his bed, leaving the other half with no protection against frost. At each picking the yield per row in the heated part was 24 to 30 hallocks (one pint containers), and in the unheated tract, from 4 to 7 hallocks per row.

The total harvest for the season showed the yield of the heated tract to be seven times as much as that of the unheated portion. The fruit loss was about 85 per cent of that harvested in the heated tract, or, in other words, a saving of 85 per cent of the crop was effected by the use of the heaters. Such a saving with the current prices would pay for all the expense of operating the heaters and in addition would yield the grower a substantial return. No temperature data or operating costs are available from this patch.

In studying the cost of heating, the unusual conditions which existed this year must be given due consideration. The unusual length of the firing periods and the record-breaking low temperatures during the 1927 season made the cost of heating somewhat greater than the average over a period of years. The real benefits derived from heating can be determined not from the records of one season only but rather by examining the data covering a period of several years with frosts of varying intensity.

It must be remembered that the cost of heating a larger tract would be somewhat less per acre than that of the test plot under discussion. The labor involved in lighting and regulating the heaters on a tract four or five times as large as the test plot would not be appreciably greater than for the test plot alone.

About one-half acre of Mr. C. A. Hoadley's strawberry bed, three-quarters of a mile south of Kennewick, was equipped with 66 Kennewick briquet heaters, with extensions on the legs so that the top of the heater was 36 inches above the plants. On the morning of April 20 the test was abandoned because of the failure of the heaters to raise the temperature sufficiently to prevent injury to the buds.

Two other growers experimenting with the same type of heater also failed because of the inefficiency of the heaters. These facts seem to show that this particular type of heater is not adapted to the successful heating of strawberries or other ground crops.

SOME RECENT TREASURES OF THE SNOW

By WILSON A. BENTLEY

[Jericho, Vt., May 22, 1927]

The past winter, 1926–27, noted for its mildness and scant snowfall in Vermont, goes on record as a fairly favorable winter for snow-crystal photography. There were 12 favorable snowfalls, and although 10 of them were light, and furnished only about a dozen photographs each, two of them—the storms of January 23 and February 22—furnished large sets of crystals (over 40 each). December furnished three favorable storms, the 4th, 6th, and 20th; January, six, the 1st, 2d, 5th, 15th, 17th, and 23d; and February, three, the 3d, 9th, and 22d. Of these, four were cold snowfalls, occurring during temperatures ranging from 5° above to 5° F. below zero.

The winter furnished about 200 new photomicrographs, among them more than the usual number of exceptional or "wonderful" crystals; 40 of them can be classed as such.

The new snow gems were doubly welcome because of the fact that recent winters, since 1920, have been rather unfavorable. The recent winters seemed to have gotten into a habit of periodicity as regards the character of their snowfall.

The winters 1912 to 1915, inclusive, were unfavorable. Those, 1916–1920, were very favorable; then followed a long period, 1921–1926, of unfavorable ones, broken only by the last winter. Looking further back over my record, I find no well-established periods. The winters 1902, 1904, 1907, 1910, and 1911 were favorable ones. Those of 1905, 1906, and 1909 were among the least favorable ones. Although the recent unfavorable period, 1921–1926, furnished a total of only 673 new snow crystal photomicrographs, an average of but 112 per winter, each winter furnished nevertheless its quota of about 7 each, of exceptional or masterpiece crystals, so that the six years' collection, as a whole, with the new ones added the last winter, is a wonderful and priceless addition to my numerous collection, now over 4,700 snow crystals.

Among the recent ones photographed during the seven year period are a few (20) that were taken in Canada at the invitation of Dr. H. T. Barnes, of McGill University.

I spent most of the winter of 1925 at Morrisburg on the St. Lawrence River, about 80 miles upriver from Montreal, carrying on my snow-crystal work there. I had wished for years to try photographic work a little farther north in Canada, because I thought it might be even more favorable for my work there than at Jericho, Vt.

The winter of 1925, however, happened to be an unfavorable one, so I was left somewhat in doubt as to whether the Canadian location was favorable or not, yet from the data secured I feel sure that the modifying influence of the Great Lakes to the westward is an unfavorable influence. The lakes tend to raise the temperature of the air both at the surface and presumably in cloudland, and thus favor the production of granular snow and granular-covered crystals; so I returned home with the query in my mind, "Could it be that through some strange freak of accident or providence, that the one man who loves the snowflakes most had been born at the one most favorable spot on earth for the study and photographing of them?"

My Canadian location, however, proved very favorable for the study and photography of hoar frost effects, both on outdoor objects and upon window panes. The water vapor evaporated from the great St. Lawrence, crystallized in forms of wonderful beauty and magnificence, particularly upon the window panes at Morrisburg and elsewhere along the great river.

Resuming once more in 1926 my work at my home location, I have succeeded in photographing many new and wonderful snow crystals the past two winters.

A brief chronological review and mention of some of the results of my more recent work during the seven-year period 1921–1927 may be of interest. Among the most wonderful crystals of this period is one (3950) that fell November 26 in the early winter of 1922. I have named it the "good luck," or horseshoe crystal. It not only has a horseshoe pictured as its nuclear feature, but more wonderful still, it has six surrounding features, each of which resembles a horse's hoof with heel calks.

The beautiful branching one that fell December 9, 1921, No. 3999, is also a masterpiece of crystal architecture.

The winter of 1923 produced among others three very exquisite specimens. One of these (No. 4149), which fell during the very cold snowfall of December 7, 1922, is a very marvellous quasi-trigonal crystal. The thrillingly beautiful one (No. 4215) of January 10, 1920, is also very notable, and also No. 4273 because of the beautiful circular arrangement of its tiny loops and scallops.

The winter of 1924 produced among others No. 4273, just mentioned, and No. 4308.

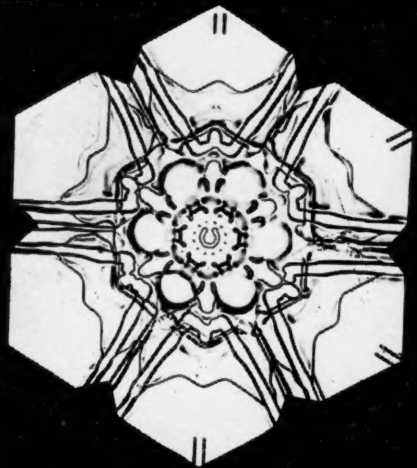
Passing over the many charming ones of the 1925 crop we come to some notable ones of 1926. The snows of the early winter of 1926 were rich in perfect snow gems. One rarely lovely one of this series is shown in No. 4538. Two of those of this winter are of surpassing interest. Both fell during the cold and heavy snowfall of February 4, 1926. This storm was rich in triangular forms and furnished many having outlines similar to the wonderful No. 4404. It also produced the marvellous No. 4408.

As previously noted, the winter of 1927 was quite favorable. The writer wishes all the readers of the REVIEW could see and enjoy the snowflake masterpieces of this winter.

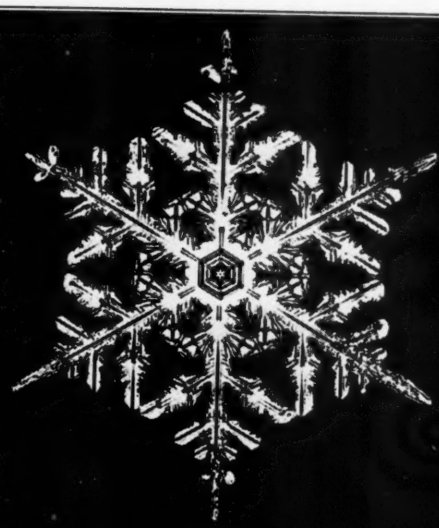
The storm of January 1 furnished among others the lovely plate-form crystal (No. 4572), and also a wonderful dotted one (No. 4562). But the storm of January 17 made itself even more famous by producing one of the oddest snow crystals ever photographed (No. 4621), named the "clock crystal" because it so much resembles the face of a clock.

Soon afterward came the storm of January 23, which made itself noted by furnishing the largest set of snow crystals yet photographed during a single storm—53. Many of these fell during the night but so thick and substantial were they that masses of them were taken indoors on a shingle into a cold room where the still air caused less evaporation and were used all day for photographic purposes. Among those of this set were some that were truly "wonder" crystals. No. 4640 has dark, shadowy features arranged around its nuclear star, forming a unique design of rare beauty. Many of the tabular plates possessed beautifully arranged systems of tiny dots and dashes as a nuclear feature. Often these were surrounded by bold, well-marked features in a similar manner to those shown in No. 4656.

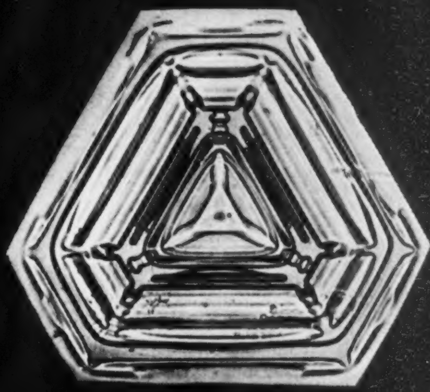
The 1927 snowflake season had an early but wonderfully brilliant closing on February 22. On that date, in the early morning, the clouds for a while showered the earth with starry, fernlike gems such as thrill, amaze, and delight snowflake lovers. Many of these crystals



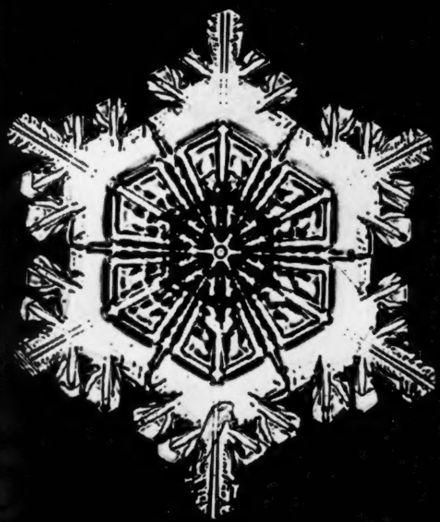
3950



3999



4149

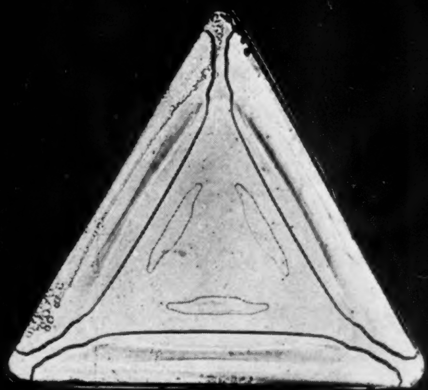


4215

4273

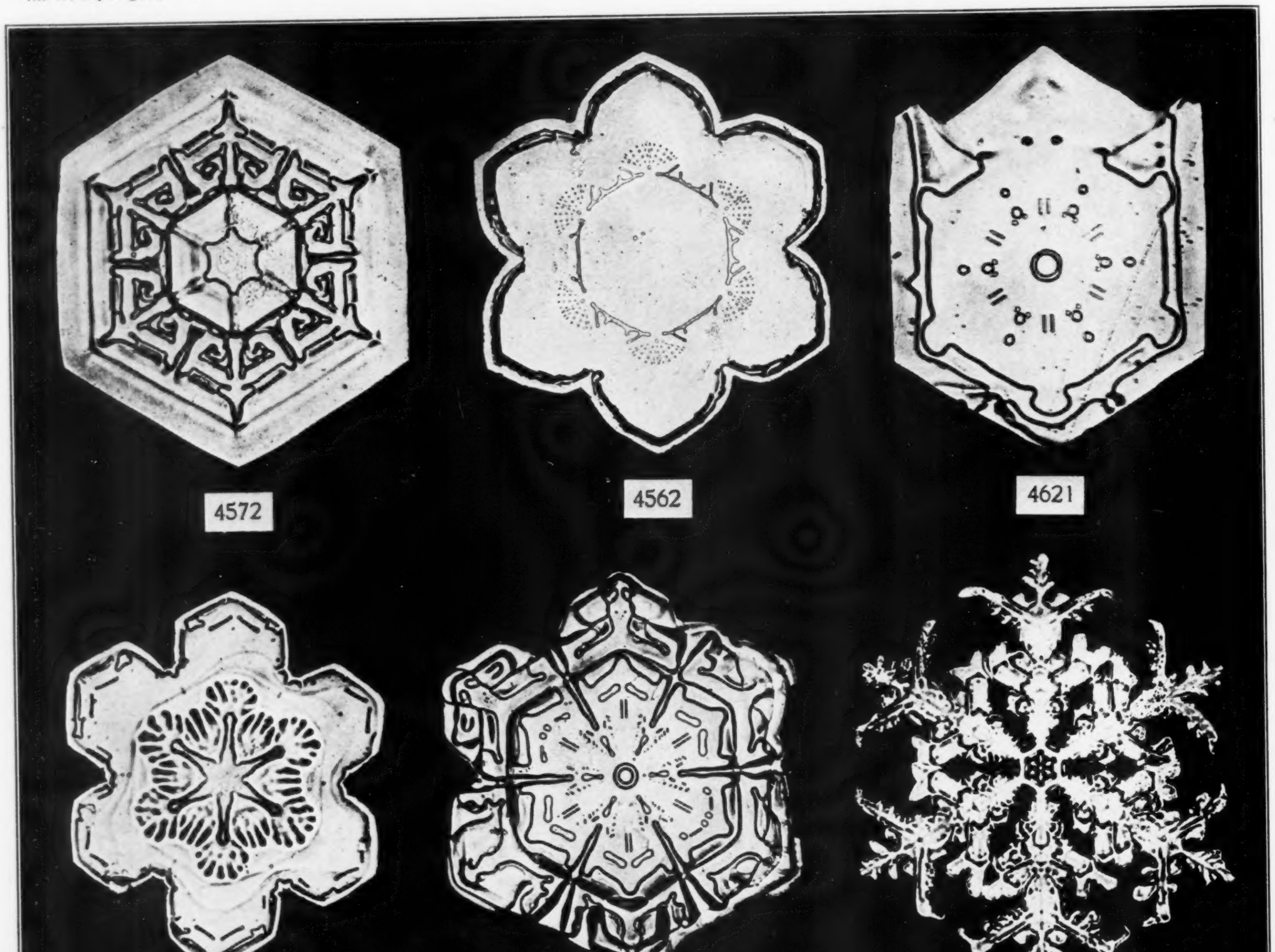
4308

4538



4404

4408


4572
4562
4621
4640
4656
4711
4695
4716
4726

were of extraordinary size, some being one-half inch in diameter. So heavy were they that many of them were broken in alighting upon my blackboard.

The snowflakes in this storm were so substantial that after the snow ceased I took quantities of them indoors and used them for photographing until nearly noon, when sunlight and rising temperature prevented further work. Although many of the crystals were somewhat deformed by unequal evaporation, the set as a whole is of exquisite beauty—a priceless addition to my series of branching crystals. It will be noted that the general effect of the arrangement of the multitudes of secondary and tertiary degree rays around the axial rays is beautifully symmetrical. Yet a closer analysis discloses that no two of the axial and pendant rays are alike, and that the secondary and tertiary degree rays are not always arranged opposite each other in pairs as is often the case. This suggests colloidal crystallization, the use by the growing crystals, in part, of groups of water molecules not completely subject to crystallographic law.

A thorough analysis of this wonderful series of branching crystals leaves one in doubt as to which ones are the most beautiful and interesting. The drooping pattern of No. 4711 recalls some of the drawings of Glaisher. The downward growth of rays of the third degree in No. 4695 forms a lovely, unique pattern. Very interesting also are the branchy rays arranged as peripheral adornments around the solid centerpiece of No. 4716.

Perhaps most interesting of all is No. 4726, because it shows so beautifully the tendency, so often seen in some form, by many hexagonal crystals, to divide into three. In this specimen it will be noted that the main secondary rays of each alternate axial ray have grown farther than those lying between them, thus forming a triangular effect.

This brief account of the newer "treasures of the snow" will perhaps once more serve to inspire renewed interest in the peerless snow gems and to emphasize the fact that the treasures of the snow are absolutely inexhaustible, almost untouched as yet.

The writer is happy in the thought of having added during recent years so many new snow gems of the "first water" to his already numerous collection of over 4,700 specimens, of which no two are alike. There is much room also for gratification in the fact that there is an ever increasing interest in snow crystals the world over, as proven by the manner in which they are being featured by the press, magazines, lecturers, museums, textbooks, and moving pictures, as well as the new uses of them as designs in the arts, crafts, and industrial sciences.

As the writer looks back 44 years to the beginning of his seemingly unimportant study of snow crystals, it seems to him remarkable that the work should have produced such undreamed of results. Perhaps it is not too much to say that the results of his studies form one of the "little romances of science."

C. E. P. BROOKS[1] ON THE EFFECT OF FLUCTUATIONS OF THE GULF STREAM ON THE DISTRIBUTION OF PRESSURE

By A. J. HENRY

It has been recognized for many years that in one way or another the Gulf Stream affects the weather of western Europe but in just what way is not so definitely known.

Doctor Brooks seeks the answer by means of a very comprehensive statistical comparison between fluctuations in the strength of the Gulf Stream and the subsequent weather.

Data as to the volume and temperature of the Gulf Stream not being available the author goes back a step to the causes which must produce variations in the volume and temperature of the water of the stream, viz, to variations in the NE. and SE. trades of the Atlantic Ocean. These as is well known give rise to the Gulf Stream. Since in its travel of several thousand miles there is the possibility that its temperature may be influenced by one or more variables along its course it was necessary to investigate the subject under the following heads:

1. NE. trades.
2. SE. trades.
3. Pressure at Habana.
4. Pressure difference Bermuda—Charleston.
5. Pressure difference Bermuda—Sydney.
6. Pressure difference Azores—Iceland.
7. Pressure difference Stornoway—Iceland.

At the outset the author investigates the rate of flow of the various branches of the Atlantic circulation and presents the results shown in Table 1 below. The rates and speeds shown are of course only the roughest approximations, yet they serve to give an idea of the time required for variations in the currents in one part of the Atlantic to be propagated along the course of the currents to other parts of the ocean.

TABLE 1.—*Speeds and times of Norh Atlantic circulation*

Current	From—	To—	Distance (nautical miles)	Speed, (miles per day)	Mean time in days
North Equatorial	16° N., 25° W.	16° N., 60 °W.	1,900	17	112
Antilles	16° N., 60° W.	23° N., 75° W.	850	12	71
South Equatorial	St. Helena	5° N., 40° W.	2,800	20	140
Guiana Current	5° N., 40° W.	20° N., 80° W.	2,400	35	69
Yucatan to Florida Strait	Round	Gulf of Mexico.	(500)	(20)	(25)
Gulf Stream:					
Florida Strait to Cape Hatteras.	23° N., 80° W.	36° N., 75° W.	600	70	9
Cape Hatteras to Newfoundland.	36° N., 75° W.	42° N., 50° W.	1,200	38	32
Newfoundland to Azores	42° N., 50° W.	40° N., 26° W.	1,200	10	120
Newfoundland to north of Scotland.	42° N., 50° W.	60° N., 5° W.	1,800	12	150

The initial assumption is that the effect of the various factors, trade winds, pressure differences, etc., are caused mainly through temperature variations carried along by the Gulf Stream and the Gulf Stream drift.

Correlation coefficients were first computed between the velocity of the NE. trade and subsequent pressure over western Europe, the final objective being, of course, the discovery of a relation that might be useful in long-range weather forecasting.

The following-named stations were used to represent the pressure over western Europe: Jacobshavn (west coast of Greenland); Stykkisholm, Iceland; Thorshavn, Faroes; Ponta Delgada, Azores; Valencia; Paris; Berlin; Bergen and Vardo, Norway.

The pressures at these stations were correlated with the trade wind velocities for the same quarter, for the preceding quarter, and so on over a period of two years. In addition to the regular quarterly coefficients representing intervals of 3, 6, 9, . . . months pressures were also correlated with the velocities of the trade wind four months earlier—i. e., pressure January to March with velocity

[1] Air Ministry, Meteorological Office, Geophysical Memoirs No. 34, by C. E. P. Brooks, D. Sc.

in the preceding September to November, pressure April to June with velocity December to February, and so on. This was because a tendency was suspected for the coefficients to reach a maximum or minimum with an interval of four months.

The quarterly coefficients between the velocity of the NE. trade and the subsequent pressure at the eight stations above named are given in Tables 3 and 5 (not reproduced) for both NE. and SE. trades and for lags of 3, 4, 6, 9, 12, 15, 18, 21, and 24 months.

From the tables the following conclusions are drawn. (Places in bold face type have coefficients of ±0.20 or greater.)

CHANGES FOLLOWING A HIGH VELOCITY OF THE NE. TRADE

After four months, high pressure at **Jacobshavn**, Stykkisholm and Vardo; low pressures at Ponta Delgada, Valencia, Paris, and Berlin.

Nine months, high pressure at **Jacobshavn**, Thorshavn and Vardo; low pressure at **Ponta Delgada.**

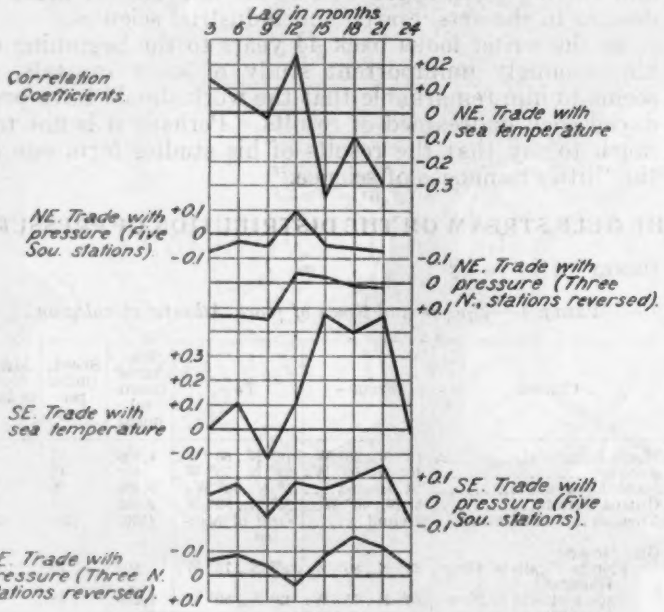


FIG. 1

Twelve months, high pressure at Valencia, Paris, Berlin, and Bergen; low pressure at Vardo.

Fifteen months, low pressure at Bergen and Vardo.

Eighteen and twenty-one months, high pressure at Jacobshavn; low pressure at **Ponta Delgada.**

CHANGES FOLLOWING A HIGH VELOCITY OF THE SE. TRADE

After three and six months, high pressure at Paris and Berlin; low pressure at Stykkisholm.

Nine months low pressure at Stykkisholm, Thorshavn, Valencia, Paris and Berlin.

Twelve months, high pressure at Jacobshavn, Stykkisholm, Thorshavn, Valencia, **Paris** and Berlin; low pressure at Ponta Delgada and Vardo.

Twenty-one months, high pressure at **Valencia, Paris** and Berlin; low pressure at Vardo.

Discussing these results the author finds that after 4 months the water which the NE. trade drives is in the neighborhood of the Antilles, after 9 months in western mid-Atlantic, and after 12 months in the longitude of the Azores. The further observation is made that since depressions which influence the pressure over western Europe often originate over the western Atlantic, the occurence in western Europe 9 or 12 months after the occasion of an abnormal wind velocity is intelligible but the effect with a lag of 4 months is not understood.

Water set in motion by the SE, trade at St. Helena will be found 9 months later off Newfoundland and 12 months later in mid-Atlantic. After 21 months it will either be in the Artic Ocean or will have partially completed a second circuit of the Atlantic, according to which major branch of the Gulf Stream drift it follows. Here again the effect at 9 months is intelligible but not at 21 months. It is remarked that the correlation coefficient between NE. and SE. trades is only +0.26.

Correlation of NE. and SE. trade with subsequent sea-surface temperature—Florida to Valencia—is next made. Fluctuations in both the strength of the trades and in sea-surface temperatures collected by Hepworth for the five years 1902–1906 were each combined in sets of three months and were correlated. The results are shown in Table 2 below.

TABLE 2.—*Correlation of NE. and SE. trade with subsequent sea-surface temperatures—Florida to Valencia*

	Lag in months							
	3	6	9	12	15	18	21	24
NE. trade	+0.13	+0.06	−0.02	+0.24	−0.35	−0.10	−0.29	....
SE. trade	+.01	+.11	−.12	+.11	+.48	+.40	+.47	−0.03

As shown by the above the maximum positive effect of the NE. trade on surface temperature is experienced after a lapse of 12 months; it is not very definite and is followed at 15 months by a more pronounced negative effect. The author further remarks that the maximum effect of the SE. trade is better shown and extends from the 15th to the 21st month.

This difference in the duration of the warming effect due to the two trade-wind systems is probably due to the difference in the configuration of the Atlantic Ocean north and south of the Equator. Owing to the great bulge of west Africa the NE. trade wind blows to a large extent off the coast. Hence a strong NE. trade soon drives into the North Equatorial Current all the available supply of warm surface water; the place of the latter is taken by relatively cold water, which is brought to the surface near the coast from the lower layers of the ocean. The SE. trade on the other hand blows almost parallel to the coast and drives before it the warm surface waters from a wide area, without bringing up the colder layers from below.

This difference in the effects of the two trade-wind systems on temperature is closely reflected in their effects on pressure. We may divide the stations considered into two groups, a southern group including Ponta Delgada, Valencia, Paris, Berlin, and Bergen, and a northern group including Jacobshavn, Stykkisholm, and Vardo. The average coefficients of correlation of trade-wind velocities with subsequent pressure are shown by the broken lines in Figure 1, the scale for the northern group being reversed so that negative coefficients appear above the positive. The SE. trade is here represented by the direct correlations of Table 5. (Not reproduced.) The correlation coefficients between the trade-wind velocities and the sea-surface temperature are shown by the continuous lines. The correlation coefficients of the trade winds with pressures at the southern group show good agreement with those of the trade winds with sea temperature, in spite of the difference in the periods utilized; those with pressure at the northern group (reversed) show a similar but not so close agreement.

A tendency also appears for the curves representing the northern group to lag behind those representing the southern group.

There is a well-known opposition between pressure in the Azores anticyclone and its northeastward extension and pressure in the Baffin Bay-Iceland-Norway coast depression, and this opposition would tend to appear in any correlation coefficients between some third variant and these pressures.

Figure 1 shows that powerful trade winds cause high temperature over the North Atlantic after an interval of 12 months for the NE.

trade and 15 to 21 months for the SE. trade, and that this high surface temperature in some way brings about a high barometric pressure over the southern part of the region and a low pressure in the northern part, so that a high surface temperature in the North Atlantic gives rise to an abnormally steep barometric gradient from south to north.

Space does not permit touching upon the many phases of the subject considered. Ten major conclusions are presented as follows:

(1) The surface temperature of the North Atlantic Ocean between Florida and Valencia has a positive correlation with synchronous pressure over the area Valencia, Bergen, Berlin, and Azores, but a negative correlation with pressure at Jacobshavn and Stykkisholm.

(2) The pressure at Jacobshavn and Stykkisholm has a positive correlation with the NE. trade wind four months before, this relationship not being due to the influence of the Gulf Stream.

(3) The surface temperature of the North Atlantic has a positive correlation with the NE. trade wind 12 months before, this relationship being due to the influence of the Gulf Stream.

(4) The surface temperature has a negative correlation with the NE. trade wind 15 to 21 months before.

(5) The correlation between the pressure in western Europe and the North Atlantic and the strength of the NE. trade wind 12 to 21 months before is generally small, but the coefficients usually have the signs to be expected from relationships (1), (3), and (4); that is, pressure at stations in the area Valencia, Bergen, Berlin, and Azores tends to have a positive correlation with the NE. trade wind 12 months before, and a negative correlation with the trade wind 15 to 21 months before.

(6) The surface temperature of the North Atlantic has a positive correlation with the velocity of the SE. trade wind 15 to 21 months before, this relationship being due to the influence of the Gulf Stream.

(7) Pressure at Valencia, Paris, Berlin, and Ponta Delgada has a positive correlation with the velocity of the SE. trade wind 15 to 21 months before; pressure at Jacobshavn, Stykkisholm, and Vardo has a negative correlation with the velocity of the SE. trade wind 15 to 21 months before.

(8) The surface temperature of the North Atlantic and the pressure at Ponta Delgada have a positive correlation with the Bermuda-Charleston pressure difference 3 to 9 months before and 15 to 18 months before.

(9) The surface temperature of the North Atlantic has a positive correlation with the Bermuda-Sydney (Nova Scotia) pressure difference three months before; the pressure at Ponta Delgada has a small positive correlation, and pressure at Jacobshavn a small negative correlation with the Bermuda-Sydney pressure difference three months before.

(10) The pressure in Western Europe and the North Atlantic (except the Azores) has a negative correlation with the pressure difference three months before between the point 50° N., 20° W. and Vestmanno, Iceland. At the Azores the correlation is positive.—*A. J. H.*

IMPROVED WATER-FLOW PYRHELIOMETER

By W. M. SHULGIN, Scientific Collaborator and Lecturer

[Timiriaseff's Academy of Rural Economy, Moscow, U. S. S. R.]

Doctor Abbot in America has constructed a water-flow pyrheliometer, which appears to be the most accurate standard apparatus for the measurement of the intensity of solar radiation yet made. My work at the meteorological observatory of the Timiariaseff's Academy of Rural Economy, Moscow, has for its object the continuation of these studies of the pyrheliometer for the purpose of improving its construction and increasing its accuracy. I describe here a method that permits the intensity of solar radiation to be measured with an accuracy of 0.1 per cent or more, depending upon the sensitiveness of the galvanometer.

The theory of the apparatus constructed by Doctor Abbot, and described in the Annals of the Astrophyical Observatory of the Smithsonian Institution, Volume III, is quite simple. In order to attain high precision a flow of water at constant temperature at all points is indispensable. For this purpose there is required a thermostat which will allow only insignificant fluctuations of temperature, not exceeding 0.0001°. This thermostat should be located as near as possible to the entrance to the pyrheliometer, and then care must be taken that the water that passes it does not change temperature before reaching the calorimeter.

Numerous experiments convinced me that in the case of an open platform and an inserted tube such a thermostat is impracticable. I have therefore planned an improvement of the apparatus itself that will obviate the necessity of constant temperature of the flowing water.

I have investigated the necessity of constant temperature of the water during considerable periods and the objections to fluctuations in temperature.

I have reached the conclusion that under certain conditions variations in temperature of the water do not interfere with the accuracy of the apparatus.

Let us suppose that first of all we have obtained a constant temperature of the flowing water. Then the readings of our two thermoelements, one at the ingress and the other at the egress, will be zero. But suddenly a column of hot water appears at the ingress. (Fig. 1.) As soon as it reaches the ingress thermoelement the latter will receive a temperature increase of t_2-t_1, and the galvanometer will record t_2-t_1 (fig. 2) until the hot column leaves the ingress thermoelement. In Figure 3 it has nearly left it; in Figure 4 it is entirely separated from the ingress thermoelement, and the galvanometer again reads zero.

As it advances the hot-water column reaches the egress thermoelement, Figure 5, and the galvanometer is deflected by a current of the same strength as before, but having the opposite sign. The galvanometer again comes to the zero line when the hot-water column leaves the egress thermoelement, Figures 6 and 7.

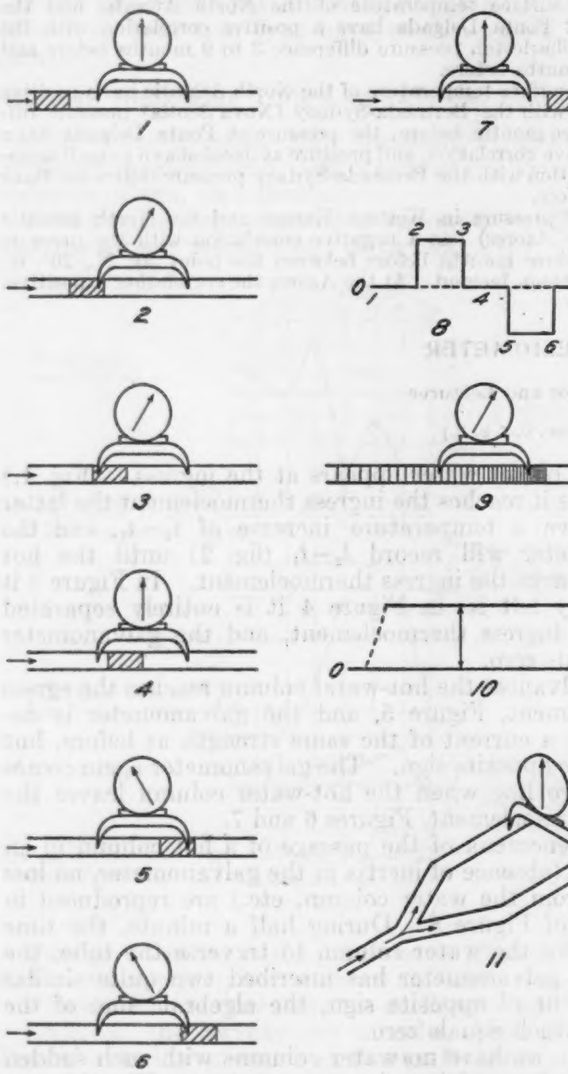
The phenomena of the passage of a hot column in an ideal case (absence of inertia in the galvanometer, no loss of heat from the water column, etc.) are reproduced in the lines of Figure 8. During half a minute, the time required for the water column to traverse the tube, the recording galvanometer has inscribed two quite similar squares, but of opposite sign, the algebraic sum of the areas of which equals zero.

Actually we have no water columns with such sudden transitions from high to low temperature. The thing to be noted is that if the hot columns follow one another regularly and their temperatures are equal, then the sum of the squares recorded on the photogram and the sum of the heat received by the calorimeter during the half-minute interval are each equal to zero.

It can even happen that the hot columns will pass the thermoelements synchronously. Then the galvanometer will record a continuous straight line, without arches or depressions, notwithstanding the variations in the temperature of the water flow. Let us indicate the length of the spiral tube of the apparatus by L, the length of the cold column by l_1, the length of the hot column by l_2. Then evidently synchronism will obtain when $\frac{L}{l_1+l_2}=$ a whole number. Therefore regular variations in the tem-

perature of the water flow do not cause errors in observations that extend over a period of more than half a minute.

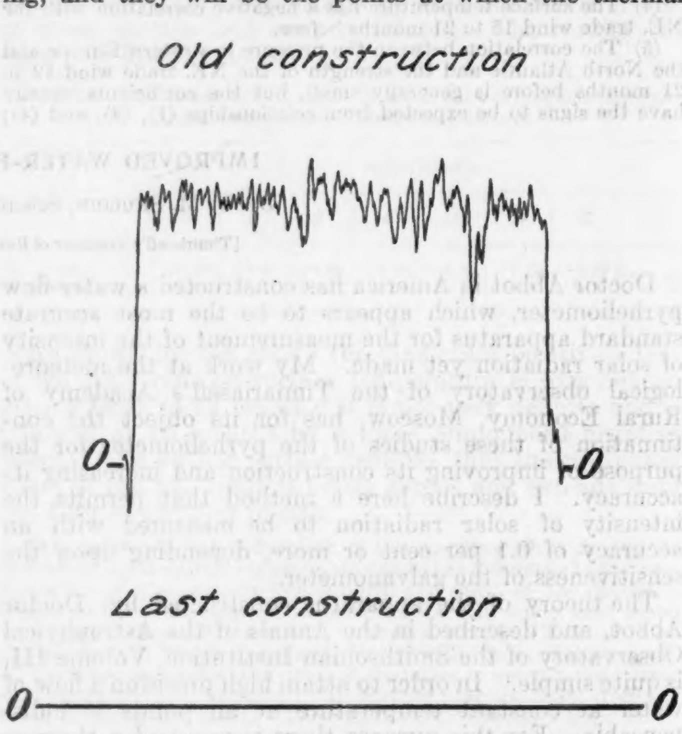
Quite a different result will be obtained if we have irregular temperature variations. Such variations are shown graphically in Figure 9, where the vertical lines indicate the temperature—the more numerous the lines the higher the temperature. Under these conditions the right-hand thermoelement will have the higher temperature and at no time will the record return to zero. Also the deviations of the galvanometer on the two sides of



zero will be unequal. On the other hand, during all this time the photogram will show increase of heat, although the waterflow that enters will continually be recorded as becoming colder. This sign of the ordinate, which in general is variable, I call the *tendency* of the *flow*. This tendency is recorded with great precision by my apparatus and in general indicated sources of error in the pyrheliometer. For instance, we may obtain a perfectly straight line a little above the zero, Figure 10, which does not mean at all that the flowing water received its heat in the calorimeter. It may mean that before entering the calorimeter the temperature of the water is unfailingly and regularly raised.

For the elimination of this temperature tendency from the records of the apparatus I had intended at first to use two spirals joined in the same Dewar vessel, which would require two galvanometers. Afterwards I worked out a method by means of which I exclude this temperature tendency of the water flow and attain a perfectly straight zero line, using only one galvanometer. The principle of the method is the following:

Let us assume a tube containing flowing water and divided into two branches, Figure 11. By means of Reynold's formula we may determine a section of the tubes that will prevent the formation of eddies. Therefore the water entering the branches will constitute two longitudinal flows of equal strength, and at the ends of the branches two points can be found where the temperature difference $t_2 - t_1$ always equals zero. These points will be found at equal distances from the place of branching, and they will be the points at which the thermal



elements will be placed. Then if one of the branches of the tube is warmed by the sun a difference of temperature will at once be indicated, as the temperature tend ency of the tube exposed to the sun is changed.

These theoretical considerations have been fully confirmed by experiments, as is seen from the photograms reproduced in Figure 12. Figure 12, upper part, shows a four-hour record made by apparatus of the old type with a thermostat placed in the path of flow. Figure 12, lower part, shows a record of more than five hours' duration constructed with a branching tube and without a thermostat. The water entered the apparatus from a plain Mariott's bottle.

Verifying the apparatus by means of a Dgaul's heater, I obtained figures deviating $= 0.1$ per cent from the mean, but I propose further improvements in construction, following the method of branching flow developed by me, provided my material means permit.

ANALYSIS OF THE PRECIPITATION OF RAIN AND SNOW AT MOUNT VERNON, IOWA

By ROBERT W. HENDRICKS

[Cornell College, Mount Vernon, Iowa, July 21, 1927]

For the past 17 years Cornell has been keeping an analysis of all the rain and snow which was precipitated here. Some of the results were published in the Chemical News, some in other periodicals of a scientific nature. Some of the references for this work done in previous years are:

Chemical News, Volume III, page 61.
Chemical News, Volume 119, page 49.

The water was collected in granite pans set on a house top in town. The town is small, with no factories. The smoke which might influence the results comes only from the residence heating plants. There are a great many trees in the town and on the campus. In the fall the leaves were troublesome in contaminating the sample. The first six samples were collected and saved, in ordinary gallon bottles, until the college opened in the fall, the 15th of September.

The method used in making the tests was taken from the Standard Methods of Water Analysis, sixth edition, published by the American Public Health Association. The chloride tests were not started until the thirteenth sample. It was found, from testing a sample of pure, chloride-free distilled water, that it was necessary to deduct from the reading 3.55 parts per million to allow for the formation of the color. It took $AgNO_3$ equivalent to this amount to make the change visible. The distillation method for free and albuminoid ammonias was used; for nitrates, the phenosulphonic acid method. All of the samples were colorless, except several in the fall, when the ammonias were high. The results of this work are given in the table below. All of the values therein are in parts per million parts of the sample.

Dr. Nicholas Knight, professor of chemistry at Cornell College, has been of invaluable assistance in this work.

TABLE 1.—*Rain and snow at Mount Vernon, Iowa*

Sample	Date of precipitation	Amount	Rain or snow	Lightning	Nitrates	Nitrites	Free ammonia	Albuminoid ammonia	Sulphates	Chlorine as chlorides
	1926									
1	June 10	0.20	R.	......	6.000	......	0.04	1.180	24.653	......
2	11	0.5	R.	......	0.8	0.0010	1.60	0.024	4.450	......
3	13	0.9	R.	......	0.400	0.0010	0.11	0.040	5.145	......
4	17	0.25	R.	......	0.400	0.0005	0.01	0.400	16.435	......
5	21	0.5	R.	......	1.200	0.0015	0.00	0.380	9.947	......
6	July 1	0.25	R.	......	0.800	0.0000	0.00	0.000	3.43	......
7	Sept. 19	2.00	R.	......	0.040	0.0030	0.05	0.020	3.43	......
8	22	0.65	R.	......	0.030	0.0040	0.36	0.030	10.29	......
9	Oct. 1	0.5	R.	Yes	0.010	0.0200	0.26	0.380	0.000	......
10	4	0.3	R.	Yes	0.020	0.0075	0.30	0.900	5.145	......
11	5	0.1	R.	No	0.120	0.0070	0.10	0.400	0.000	......
12	19	0.15	R.	No	0.200	0.0200	0.00	0.000	0.000	......
13	23	0.2	R.	No	0.010	0.0070	0.24	0.100	0.000	1.36
14	Nov. 3	0.1	R. & S.	No	......	0.0000	0.72	2.200	0.000	......
15	9	0.5	R.	No	0.080	0.0060	0.22	0.360	6.890	2.13
16	12	0.5	R.	No	0.010	0.0040	0.03	0.400	5.480	1.42
17	14	1.0	R.	No	0.005	0.0030	0.04	0.320	8.540	0.00
18	16	12.0	S.	No	0.020	0.0005	0.04	0.030	0.000	0.71
19	26	2.85	R.	Yes	0.060	0.0015	0.64	0.000	0.000	0.00
20	Dec. 6	2.0	S.	No	0.140	0.0060	......	......	......	17.04
21	7	6.0	S.	No	0.010	0.0015	0.00	0.002	0.000	1.06
22	24	0.25	R.	No	0.200	0.0016	0.80	2.000	49.730	11.36
	1927									
23	Jan. 13	6.00	S.	No	0.020	0.0070	0.10	0.180	......	120.7
24	19	3.0	S.	No	0.140	0.0100	......	......	......	77.39
25	Feb. 5	0.8	R.	No	0.140	0.0080	0.24	0.020	......	0.00
26	14	6.0	S.	No	......	0.0020	......	......	0.000	0.00
27	24	3.0	R.	No	0.100	0.0080	0.72	0.020	0.000	1.42
28	25	2.0	S.	No	0.700	0.0080	......	......	......	3.60
29	Mar. 5	0.2	R.	No	0.160	0.0300	0.80	0.320	......	4.61
30	11	0.85	R.	No	0.030	0.0050	0.36	0.400	......	0.00
31	16	0.4	R.	Yes	0.100	0.0060	0.20	0.136	0.000	12.07
32	21	1.0	R.	No	0.020	0.0005	0.36	0.020	......	0.00
33	23	0.25	R.	No	0.140	0.0100	0.20	0.000	......	0.00

TABLE 1.—*Rain and snow at Mount Vernon, Iowa*—Continued

Sample	Date of precipitation	Amount	Rain or snow	Lightning	Nitrates	Nitrites	Free ammonia	Albuminoid ammonia	Sulphates	Chlorine as chlorides
	1927									
34	Apr. 1	0.9	R.	No	0.180	0.0050	0.24	0.001	......	0.71
35	3	0.2	R.	No	0.300	0.0070	0.40	0.136	......	0.00
36	4	0.4	R.	No	0.600	0,0030	0.37	0.160	......	5.68
37	8	0.33	R.	No	0.600	0.0090	0.10	0.000	......	4.25
38	10	0.18	R.	No	0.300	0.0050	0.22	0.360	......	0.71
39	13	0.75	R.	No	0.400	0.0040	1.00	0.560	......	0.00
40	15	0.6	R.	No	0.020	0.0060	0.28	0.020	0.000	4.26
41	18	0.12	R.	No	0.040	0.0080	1.20	0.240	Trace.	0.00
42	19	0.45	R.	No	0.000	0.0040	0.16	0.075	0.000	0.00
43	19	0.6	R.	No	0.010	0.0020	0.16	0.112	0.000	0.00
44	21	0.3	R. & S.	No	0.010	0.0060	0.40	0.320	......	0.71
45	29	0.4	R.	Yes	0.010	0.0080	0.80	0.320	......	4.26
46	May 2	0.28	R.	Yes	0.010	0.0080	1.10	0.280	......	1.42
47	8	1.8	R.	Yes	0.010	0.0030	0.50	0.180	......	1.40
48	9	0.12	R.	No	0.001	0.0100	......	......	......	0.00
49	13	0.45	R.	Yes	0.060	0.0050	0.56	0.136	......	0.00
50	17	2.5	R.	Yes	0.010	0.0120	1.20	0.160	......	0.00
51	18	0.65	R.	Yes	0.050	0.0030	0.56	1.320	......	1.42
52	22	0.70	R.	No	0.060	0.0040	1.20	0.360	......	0.00
53	23	0.70	R.	Yes	0.060	0.0020	0.16	0.240	......	0.00
54	24	0.55	R.	Yes	0.030	0.0050	0.28	0.150	......	0.00
55	28	0.50	R.	No	0.120	0.0100	1.12	0.280	......	0.00

TABLE 2.—*Data from Table 1 converted to pounds per acre*

[1 inch of rain over an acre=226,875.0 pounds. 12 inches of snow=1 inch of rain]

Number	Amount of precipitation in pounds per acre	Nitrates	Nitrites	Free ammonia	Albuminoid ammonia	Sulphates	Chlorides
1	4.52×10^{4}	270.0×10^{-6}	......	1.80×10^{-3}	5.31×10^{-3}	1.1070	......
2	11.30	90.4	1.13×10^{-4}	180.80	0.27	0.5028	......
3	20.34	81.3	2.03	223.7	0.81	1.0454	......
4	5.65	22.6	0.28	0.5	2.26	0.9184	......
5	11.30	135.6	1.69	0.0	4.29	1.1240	......
6	5.65	45.2	0.00	0.0	0.00	0.1948	......
7	45.20	18.0	73.56	22.6	0.90	1.5503	......
8	14.79	4.4	5.88	52.9	0.44	1.4994	......
9	11.30	1.1	22.60	29.3	4.29	0.0000	......
10	6.78	1.3	5.02	20.1	6.03	0.3443	......
11	2.26	2.7	1.58	24.8	0.90	0.0000	......
12	3.39	6.7	6.78	0.0	0.00	0.0000	......
13	4.52	0.4	3.16	10.8	0.45	0.0000	0.0614
14	2.26	......	0.00	16.2	4.97	0.0000	......
15	11.30	9.0	6.78	24.8	4.06	0.7785	0.2426
16	11.30	1.1	4.52	3.3	4.52	0.6192	0.1604
17	22.60	1.1	6.78	9.0	7.13	1.9300	0.0000
18	22.60	4.5	1.13	9.0	0.67	0.0000	0.1604
19	64.41	38.6	9.66	412.2	0.00	0.0000	0.0000
20	3.76	5.2	2.25	......	......	......	0.6392
21	11.30	1.1	1.69	0.0	0.02	0.0000	0.1197
22	5.65	11.3	0.90	45.2	11.30	2.8100	0.6418
23	11.30	2.26	7.91	11.3	2.03	......	13.5600
24	5.65	7.91	5.65	......	......	......	4.3725
25	18.08	25.20	14.40	43.20	0.36	......	0.0000
26	11.30	......	2.26	......	......	0.0000	0.0000
27	77.80	77.80	62.24	560.16	1.55	0.0000	1.0837
28	3.76	26.34	3.008	......	......	......	0.1353
29	4.52	7.23	13.56	36.16	1.44	......	0.2083
30	19.21	5.76	9.60	69.15	7.68	......	0.0000
31	9.04	9.04	5.40	18.08	1.17	0.0000	1.0863
32	22.60	4.52	1.13	81.36	0.25	......	0.0000
33	5.65	7.84	8.96	11.20	0.00	......	0.0000
34	20.34	36.54	10.15	48.72	0.02	......	0.1441
35	4.52	13.50	3.15	18.00	0.58	......	0.0000
36	9.04	54.00	2.70	33.30	1.44	......	0.5112
37	7.53	45.00	6.75	7.50	7.50	......	0.3187
38	4.06	12.18	2.30	8.80	1.44	......	0.0284
39	16.95	67.60	6.76	169.50	9.46	......	0.0000
40	13.56	2.70	8.10	37.80	0.27	0.0000	0.5751
41	2.71	1.08	2.16	32.40	0.64	Trace.	0.0000
42	10.17	0.00	4.04	16.16	0.75	0.0000	0.0000
43	13.56	1.35	2.70	21.60	1.51	0.0000	0.0000
44	6.78	0.67	4.02	26.68	2.14	......	0.0475
45	9.04	0.90	7.20	72.00	2.88	......	0.3834
46	6.32	0.63	5.04	69.30	1.76	......	0.0894
47	40.68	4.06	12.18	203.00	7.30	......	0.5684
48	2.71	0.02	2.70	......	......	......	0.0000
49	10.17	6.06	5.05	56.56	1.37	......	0.0000
50	56.50	5.65	67.80	678.00	9.04	......	0.0000
51	14.69	7.30	4.38	81.76	19.27	......	2.0732
52	15.82	9.48	6.32	189.96	5.78	......	0.0000
53	15.82	9.48	3.16	25.28	3.79	......	0.0000
54	12.43	3.72	6.20	34.72	1.86	......	0.0000
55	11.30	13.56	11.30	126.56	3.16	......	0.0000

ON THE UNIT OF RADIATION USED IN METEOROLOGICAL TREATISES ON ACTINOMETRY

By ANDERS ÅNGSTRÖM

[Statens Meteorologisk-Hydrografiska Anstalt, Stockholm, Sweden, Aug. 1927]

This question has recently been brought into discussion by Sir Napier Shaw,[1] who wishes to replace the unit hitherto commonly used—namely, *gram calory per square centimeter* with *kilowatt per square dekameter*. This unit has also, at least to some extent, been adopted by H. H. Kimball in his very valuable survey on actinometric data published in the MONTHLY WEATHER REVIEW, April, 1927.

To the present author it seems to be a very serious step to leave the uniformity of units, which hitherto has been a favorable characteristic of actinometric works of almost all countries, in order to introduce a duplicity of units, which necessarily will follow as a consequence if the proposal of Sir Napier Shaw should get adherers.

I can not find that the disadvantages hereof will be balanced by corresponding advantages.

In all the classical works of Langley, Knut, Ångström, Abbot and Fowle, Dorno, and others, the unit commonly used has been the gram calory per square centimeter, and it is highly important that the results of later investigators can be easily compared with the works already done without troublesome computations and reductions.

Further, it seems that in this case the gram calory is the most natural and logical unit. In all measurements of radiation within meteorology, the radiation is transformed into heat and not into electric energy, and the adopted unit of heat energy is the gram calory. I perfectly agree to the views of Mr. W. H. Dines, who in discussing this matter with Sir Napier Shaw in Nature of August 6, 1927, says:

> Also the gram calory lends itself very readily to the expression of the first result of radiation—namely, to changes of temperature; thus, by easy mental arithmetic the thickness of ice that can be melted, or of water that can be evaporated, or the change of temperature of a given layer of air is readily calculated.

This is certainly true. Against this we have the argument of Sir Napier Shaw that "the kilowatt is the unit that engineers use to represent electrical power; solar energy is thereby brought into the same category as the energy which men buy or sell."

It may be readily admitted that in popular treatises or in publications where it is aimed at the interest of certain groups of readers it sometimes may be of value to introduce other units than those commonly used in scientific papers. But this seems to me to be no reason why a scientific and logical unit commonly used should be abandoned.

The chief aim here is *uniformity*. If one or the other unit is used seems of minor importance as long as the one can be obtained from the other simply through multiplication with a reduction factor. The only way to secure uniformity is to adhere to the unit hitherto used in actinometric investigations—namely, the gram calory per square centimeter.

[1] Manual of Meteorology, vol. 1, Cambridge, 1926, p. 237.

NOTES AND ABSTRACTS

TORNADO AT CARRABELLE, FLA.[1]

A tornado occurred at Carabelle, Fla., on August 15, 1927. At that time Carabelle was within the southern extremity of a trough of low pressure that extended from New England to Florida. The pressure and temperature gradients over Florida and adjoining regions were feeble and thunderstorms occurred quite generally in the region where the tornado occurred. The latter is described as having a pendant funnel cloud, very dark with an appearance of red in the center. This cloud was in the northwest and was met by another cloud of not quite so menacing appearance coming from the opposite direction. There was intense lighting and continuous thunder. Rain fell in torrents for a few minutes; the catch in a 30 minute period was 2.12 inches. No lives were lost but the property damage amounted to about $55,000.

PRECIPITATION IN SOUTH AMERICA

Franze, Bruno: *Die Niederschlagsverhältnisse in Südamerika. Ergänzungsheft Nr. 193 zu Petermanns Mitteilungen.* Gotha. Justus Perthes. 1927.

In the assembling of this collection of monthly and annual averages of precipitation for the several divisions of South America Doctor Franze has made the contribution of a very valuable reference work. The data previously available in a single work, those published about 20 years ago by E. L. Voss[2] and Dr. Julius Hann,[3] give no information at all on conditions over large areas and some that has proven to be very inaccurate due to the scant material at hand at that time.

The recent increase in the number of stations in those countries where the network formerly covered the entire area in a general way and the wide extension of the field toward the interior in others, together with accumulation of additional data through a rather long period, have made possible his comprehensive rainfall map, which shows interesting features not charted by E. van Cleef[4] in 1921.

A comparison of the areas covered in the older works with those over which precipitation can be charted to-day shows highly satisfactory progress in Dutch Guiana, British Guiana, and Venezuela, where the frontier stations are now on the border of the unexplored highland, and also in the upper Amazon Valley (Amazonas), where the points of observation are at present well distributed over a vast area in which conditions were formerly entirely unknown. In the temperate zone a noteworthy advance in the determination of the distribution of precipitation has followed the establishment of stations in the interior and along the southern coast of Chile.

In the descriptive text, the tables giving geographic coordinates, elevations, lengths, and periods of records, and the monthly and annual means of precipitation with the sources from which they were obtained, Doctor Franze presents a finished work.—*W. W. Reed.*

[1] Condensed from a report by Meteorologist J. E. Sanders.
[2] *Handbuch der Klimatologie*, Stuttgart. 1908.
[3] *Die Niederschlagsverhältnisse von Sudamerika, Ergänzungsheft Nr. 157 zu Petermanns Mitteilungen.* Gotha. 1907.
[4] Rainfall Maps of Latin America. Monthly Weather Review. Vol. 49, pp. 537-540.

MEASUREMENTS OF THE AMOUNT OF OZONE IN THE EARTH'S ATMOSPHERE AND ITS RELATIONS TO OTHER GEOPHYSICAL CONDITIONS. PART 2[5]

By G. M. B. DOBSON, D. N. HARRISON, and J. LAWRENCE

[Reprinted from *Science Abstracts*, July 25, 1927, p. 557]

The results of simultaneous measurements of the amount of ozone in the upper atmosphere are tabulated

[5] Roy. Soc. Proc., Apr. 1, 1927, 114: 521-541.

for Oxford, Valentia, Lerwick, Abisko (North Scandinavia), Lindenberg (Berlin), and Arosa (southeastern Switzerland), slight corrections being applied to get more satisfactory values than those in the earlier paper. (See Abstract 1532, 1926.) (1) The annual variation with a maximum in April and a minimum in October is confirmed. (2) The departure of the amount of O_3 from the mean is found to be greater for days of high H than for days of low H, while the effect is more marked on days on high magnetic character. (3) The connection found with sunspots in 1925 broke down in 1926, and more observations are required, of which those from Montezuma will be most useful. (4) O_3 content is low for anticyclones and high for depressions, while for the latter the value is higher in the rear than in the front, as if the origin of the air affected the amount of O_3. An even closer relation exists for pressure in the stratosphere than for that at the surface. (5) O_3 may exist at a level such as 10 to 20 kilometers and not only in the higher levels. The lower layer is probably connected with anticyclones and depressions, and the upper layer with solar and magnetic conditions and probably also with the annual variations.—*R. S. R.*

METEOROLOGICAL SUMMARY FOR SOUTHERN SOUTH AMERICA, JULY, 1927

By J. BUSTOS NAVARRETE, Director

[Observatorio del Salto, Santiago, Chile]

During July the atmospheric circulation showed relatively moderate activity; in general, rain did not fall very frequently and there was a marked deficiency in the amounts received.

The most important cyclonic centers, accompanied by fair, cold weather, were charted through the following periods: 1st to 5th, 6th to 11th, 15th to 18th, and 22d to 31st. The first of these made itself felt in all of Chile and in a large part of Argentina.

The depressions most productive of unsettled weather and rain were those of the 1st–2d, crossing the extreme southern region; the 2d, lying off Isla Mocha; the 8th–15th, bringing heavy storms of rain and wind over a considerable area; the 18th–22d; and the 26th–31st, causing dense fog in all of the land.

Rains fell over the region extending from the Provinces of Atacama and Coquimbo on the north to Magellanes on the south. At Santiago the precipitation for the month was 112.2 mm. (4.42 inches), while at Valdivia it was 282.7 mm. (11.13 inches).—*Transl.—W. W. R.*

METEOROLOGICAL SUMMARY FOR BRAZIL, JULY, 1927

By J. DE SAMPAIO FERRAZ, Director

[Directoria de Meteorologia, Rio de Janeiro]

The secondary circulation continued active in this month with four migratory anticyclones and frequent changes of pressures. Temperature was particularly low in southern Brazil, with general frosts and high winds in the first and last decades.

Rainfall was plentiful in the north and scarce in the center and south. Good harvest of cotton, cane, cocoa, and coffee.

Rio's pressure was 3.7° millibars above normal and temperature was 0.7° C. under normal. Weather was generally fair in the capital with only one occurrence of high wind, from SSW., on the 24th.

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SOLAR OBSERVATIONS

SOLAR AND SKY RADIATION MEASUREMENTS DURING AUGUST, 1927

By IRVING F. HAND, Solar Radiation Investigations

For a description of instruments and exposures and an account of the method of obtaining and reducing the measurements the reader is referred to the REVIEW for January, 1924, **52**:42, January, 1925, **53**:29, and July, 1925, **53**:318.

From Table 1 it is seen that solar radiation intensities averaged above normal at both Madison and Lincoln, but below normal at Washington.

Table 2 shows an excess in the total radiation received on a horizontal surface from the sun and sky at Madison and a decided deficiency at Washington and Lincoln. August weather at Washington was marked for its haziness in general.

Skylight polarization measurements made at Washington on three days give a mean of 44 per cent, with a maximum of 47 per cent on the 5th. At Madison measurements made on nine days give a mean of 64 per cent, with a maximum of 73 on the 9th. The Madison values are close to normal values, but the values for Washington are much below average August determinations.

TABLE 1.—*Solar radiation intensities during August, 1927*

[Gram-calories per minute per square centimeter of normal surface]

WASHINGTON, D. C.

Date	Sun's zenith distance: 8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass: A. M.					P. M.				Local mean solar time
	e.	5.0	4.0	3.0	2.0	*1.0	2.0	3.0	4.0	5.0	e.
	mm.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	mm.
Aug. 5	13.61	0.30	0.39	0.52	0.74	1.05					13.61
10	8.81					1.39	1.10				9.41
15	14.60				0.73						13.13
16	10.21					1.41	1.14	0.91			7.87
29	12.24			0.78	0.91						12.68
30	12.68			0.44	0.70						12.24
Means		(0.30)	(0.39)	**0.58**	**0.77**	**1.28**	**(1.12)**	**(0.91)**			
Departures		**−0.34**	**−0.28**	**−0.16**	**−0.15**	**+0.05**	**+0.10**	**+0.03**			

* Extrapolated.

TABLE 1.—*Solar radiation intensities during August, 1927*—Con.

MADISON, WIS.

Date	Sun's zenith distance: 8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass: A. M.					P. M.				Local mean solar time
	e.	5.0	4.0	3.0	2.0	*1.0	2.0	3.0	4.0	5.0	e.
	mm.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	mm.
Aug. 3	8.48				1.19						7.87
5	10.97				1.10						9.47
6	10.97				1.14						13.61
9	7.87				1.29	1.43					7.29
10	8.18				1.21						7.87
11	8.48				0.97						13.61
20	8.48				1.15						8.81
23	9.47					1.35					10.21
24	7.04			1.11	1.25	1.43	1.24				7.87
31	12.24					1.35	1.08				10.59
Means				**(1.11)**	**1.16**	**1.39**	**(1.16)**				
Departures				**+0.07**	**+0.06**	**+0.08**	**+0.09**				

LINCOLN, NEBR.

Date	8 a.m. (e.)	5.0	4.0	3.0	2.0	*1.0	2.0	3.0	4.0	5.0	Noon (e.)
Aug. 5	15.11					1.26	1.02	0.83			15.65
6	15.11				1.13	1.32					18.59
12	13.61			0.99	1.28	1.32					15.11
17	10.59		0.73	0.88	1.13	1.39					12.24
19	16.33	0.73	0.84	1.04	1.28	1.45					7.87
20	8.48		0.77	0.91	1.18	1.47					8.81
23	9.47	0.79	0.89	1.02	1.20	1.46	1.12	0.95	0.81		7.87
25	10.59					1.32	1.05	0.87	0.69		10.59
Means		**(0.76)**	**0.82**	**0.97**	**1.20**	**1.37**	**1.06**	**0.88**	**(0.75)**		
Departures		**+0.10**	**+0.05**	**+0.07**	**+0.12**	**+0.07**	**−0.01**	**−0.01**	**±0.00**		

TABLE 2.—*Solar and sky radiation received on a horizontal surface*

[Gram-calories per square centimeter of horizontal surface]

Week beginning	Average daily radiation: Washington	Madison	Lincoln	Chicago	New York	Twin Falls	Average daily departure from normal: Washington	Madison	Lincoln
1927	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.
July 30	340	525	475	443	326	729	−99	+59	−55
Aug. 6	442	500	455	383	376	588	−4	+50	−40
13	421	372	394	347	303	559	−4	−53	−91
20	395	525	458	393	251	606	−12	+89	−36
27	355	427	414	356	188	589	−61	+19	−42
Deficiency since first of year on Sept. 2							−8890	−3,346	−7,133

POSITIONS AND AREAS OF SUN SPOTS

[Communicated by Capt. C. S. Freeman, Superintendent U. S. Naval Observatory]

[Data furnished by Naval Observatory, in cooperation with Harvard, Yerkes, and Mount Wilson observatories]

Date	Eastern standard civil time	Heliographic		Area [1]	
		Longitude	Latitude	Spot	Group
1927	h. m.	°	°		
Aug. 1 (Naval Observatory)	12 0	−67.0	−16.5	-------	62
		+0.5	+13.5	15	-------
		+38.0	+9.5	-------	46
		+63.5	−11.0	247	-------
Aug. 2 (Naval Observatory)	11 49	−53.0	−17.5	-------	93
		−34.0	−8.0	-------	46
		−7.0	−17.0	-------	31
		+51.0	+11.0	-------	62
		+53.5	+20.5	-------	31
		+78.0	−10.5	278	-------
Aug. 3 (Harvard)	13 23	−39.0	−17.0	-------	319
		+68.0	+21.5	-------	388
Aug. 4 (Naval Observatory)	14 26	−26.0	−17.5	-------	62
		+23.0	−17.0	-------	123
		+57.0	+11.5	-------	31
		+83.0	+20.0	-------	247
Aug. 5 (Naval Observatory)	11 52	−13.5	−17.5	-------	46
		+34.5	−17.0	-------	154
		+68.0	+11.5	15	-------
Aug. 6 (Naval Observatory)	11 36	−2.5	−18.5	-------	15
		+22.5	−6.5	-------	46
		+43.5	−15.0	-------	62
		+50.5	−17.0	-------	77
Aug. 7 (Naval Observatory)	11 38	+12.0	−18.5	-------	15
		+37.0	−6.5	-------	15
		+57.5	−15.0	-------	62
		+65.0	−17.5	-------	93
Aug. 8 (Harvard)	11 17	+10.5	+32.5	154	-------
		+72.5	−13.5	104	-------
Aug. 9 (Naval Observatory)	12 42	−77.0	−13.5	185	-------
		−66.5	−13.0	93	-------
Aug. 10 (Naval Observatory)	11 29	−62.5	−13.5	-------	185
		−53.0	−12.5	-------	93
Aug. 11 (Naval Observatory)	11 39	−50.0	−13.5	-------	123
		−39.5	−12.0	-------	77
		−33.0	−11.5	-------	31
Aug. 12 (Naval Observatory)	11 40	−37.0	−13.5	-------	93
		−27.5	−11.5	-------	93
		−21.0	−10.5	-------	93
Aug. 13 (Naval Observatory)	11 34	−22.5	−13.0	-------	46
		−13.0	−11.0	-------	46
		−8.0	−10.0	-------	216
Aug. 14 (Harvard)	12 15	−64.5	−17.5	-------	267
		−40.0	−6.5	122	-------
		+7.0	−9.5	-------	872
Aug. 15 (Naval Observatory)	11 40	−53.5	−18.5	-------	123
		−21.0	−7.5	-------	15
		+18.5	−10.5	-------	648
Aug. 16 (Naval Observatory)	11 44	−63.0	+11.0	-------	93
		−57.5	+10.0	-------	62
		−38.0	−18.5	-------	247
		+32.0	−11.0	-------	741
Aug. 17 (Naval Observatory)	11 45	−85.0	−10.5	309	-------
		−50.5	+10.5	-------	31
		−42.5	+10.0	31	-------
		−24.0	−18.5	-------	154
		+0.5	−8.0	-------	93
		+46.0	−11.0	-------	864

[1] Areas are corrected for foreshortening and are expressed in millionths of sun's visible hemisphere.

POSITIONS AND AREAS OF SUN SPOTS—Continued

Date	Eastern standard civil time	Heliographic		Area	
		Longitude	Latitude	Spot	Group
1927—Continued	h. m.	°	°		
Aug. 19 (Naval Observatory)	11 47	−58.0	−10.5	370	-------
		−25.0	+10.5	12	-------
		−18.0	+10.0	9	-------
		−13.5	+10.5	19	-------
		+5.5	−17.5	93	-------
		+27.5	−8.0	-------	62
		+59.0	−13.0	-------	62
		+72.0	−10.5	-------	926
Aug. 20 (Yerkes)	9 26	−44.0	−9.0	125	-------
		−5.0	+10.0	-------	150
		+17.0	−14.0	75	-------
Aug. 21 (Naval Observatory)	11 39	−55.0	+16.5	31	-------
		−31.0	−11.0	247	-------
		+9.0	+10.5	-------	154
		+32.0	−17.0	108	-------
Aug. 22 (Yerkes)	9 50	−16.0	−9.5	150	-------
		+20.0	+10.0	-------	150
		+44.0	−15.0	50	-------
Aug. 23 (Naval Observatory)	12 10	−66.0	−18.0	-------	309
		−4.0	−10.5	278	-------
		+36.0	+11.0	-------	370
		+59.0	−17.5	93	-------
Aug. 24 (Naval Observatory)	11 47	−55.5	−17.5	-------	185
		−52.0	−18.0	216	-------
		+9.5	−10.5	278	-------
		+49.5	+10.5	-------	370
		+73.0	−17.5	93	-------
August 25 (Yerkes)	9 17	−35.0	−15.5	-------	75
		+20.5	−9.0	100	-------
		+59.0	+10.5	-------	125
August 26 (Yerkes)	9 30	−27.0	−16.0	-------	300
		+35.0	−9.0	100	-------
		+80.0	+11.0	-------	125
August 27 (Yerkes)	9 9	−15.0	−15.5	-------	300
		+48.0	−9.0	100	-------
August 29 (Naval Observatory)	11 31	−79.0	+7.0	-------	31
		−48.0	−18.0	-------	62
		+12.5	−18.0	-------	494
		+77.0	−10.0	-------	216
August 30 (Naval Observatory)	11 41	−72.0	−14.5	15	-------
		−38.0	−17.0	-------	31
		−34.0	−18.0	-------	46
		+27.0	−17.5	-------	309
August 31 (Naval Observatory)	11 40	−62.0	−14.5	-------	216
		−24.0	−17.5	-------	93
		+39.0	−17.5	-------	278

CORRECTED MEANS OF SUN SPOTS FOR JULY 22 AND 29, 1927

Date	E. S. T.	Hel. lat.	Hel. long.	Area
	h. m.	°	°	
July 22 (Yerkes)	18 2	−9.5	−65.0	450
		+21.5	−34.0	100
July 29 (Yerkes)	10 19	−8.0	+23.5	-------
		+24.5	+52.5	-------

AEROLOGICAL OBSERVATIONS

By W. R. Stevens

The averages for the aerological stations, given in Tables 1 and 2, show some important departures from the normal. Free-air temperatures were below the average at Broken Arrow, Ellendale, Royal Center, and Washington, near normal at Groesbeck, and below normal at Due West near the surface, with positive departures at higher levels. Ordinarily, departures from average, or normal, decrease in magnitude with increasing altitude, but we find the opposite relationship existed for the month at Due West, Ellendale, Royal Center, and Washington. Lowest temperatures of record for August were observed at Broken Arrow from 1,250 to 5,000 meters, from the surface to 1,250 meters at Due West, and from 3,000 to 4,000 meters at Groesbeck. Highest temperatures of record for August were observed at Due West from 1,000 to 3,000 meters.

Free-air relative humidities were mostly below average at Groesbeck, Royal Center, and Washington, and above average at Broken Arrow, Due West, and Ellendale.

Vapor pressures were mostly below average.

Resultant winds, as determined by kites, show that in general a more northerly component than usual prevailed over all stations with the exception of Due West and Ellendale. Nevertheless, at the latter station temperatures were subnormal by 2° C. or more at all observed levels.

The lowest temperature recorded at the surface during the month at Ellendale was on the 9th in the rear of a HIGH, where the surface wind had shifted to southerly. We find a fall of 4.7° C. from the 8th to the 9th at the surface with a wind shift from NNW. to SSW. At an altitude of 2,000 meters, however, there was a rise of 4.3° C. with a shift from NNW. to W. It is quite obvious that the inversion off the ground on the 9th was not due to a wedgelike advance of cold air, but rather to a rapid increase in temperature aloft.

Meteorological conditions over Ellendale, N. Dak., August 8–9, 1927

Time	8th		Wind		Time	9th		Wind	
	Altitude	Temperature	Direction	Velocity		Altitude	Temperature	Direction	Velocity
	meters	*° C.*				*meters*	*° C.*		
6:33 a. m.	444	10.7	NNW	6.3	6:32 a. m.	444	6.0	SSW	2.2
	500	10.5	NNW	6.5		500	6.8	SSW	3.5
	750	9.6	NNE	7.5		750	10.6	SW	9.1
	1,000	8.3	NNE	7.8		1,000	11.8	SW	11.2
	1,250	6.8	N	7.9		1,250	10.6	WSW	9.7
	1,500	5.2	N	10.7		1,500	9.4	WSW	8.3
	2,000	2.7	NNW	-------		2,000	7.0	W	5.4

A double-theodolite pilot-balloon observation of 85 minutes was made at Groesbeck on the 9th. This is the longest, but not the highest, two-theodolite ascension made at that station since it was established. The observation was made in the southwest quadrant of a high-pressure area which was central over the upper Mississippi Valley. From the second to the sixth minute the balloon ascended at a rate of only 37 m. p. m. instead of the standard inflation rate of 180 m. p. m., which indicates the presence of a descending current of 2.4 m. p. s. After the seventh minute the rate increased, the mean rate from the tenth to the eighty-fifth minute being 188 m. p. m.

On the morning of the 13th a pilot balloon was observed at Groesbeck with one theodolite for 105 minutes. If the balloon ascended at the normal rate throughout the entire ascent, it would have reached an altitude of over 19 km. Another ascension was made immediately afterward in order to check the first. The second observation showed a decrease in velocity from 500 to 1,000 meters. This was to be expected, since velocities near the surface generally decrease rapidly after sunrise. The velocities showed a marked similarity from 1 to 7 kilometers. Above this level the second ascent showed slightly increased velocities. This appears to be correct, as the observation on the afternoon of this date showed a general increase in velocities over those recorded in the morning. While the second ascent did not reach quite as high as the first, there seems to be no doubt as to the accuracy of the first observation because of the absence of high velocities which would certainly have been recorded had the balloon failed to ascend.

The highest kite flight since the station was established was made at Royal Center on the 1st, when an altitude of 6,013 meters was reached. The observation was made in front of a moderate area of high pressure which covered the northern Plains States and the Canadian Northwest. The wind was west at all altitudes observed except near the surface, where it shifted toward the end of the flight to north-northwest. The wind velocity gradually increased from 4.0 m. p. s. at the surface to 15.5 m. p. s. at the maximum altitude. The descent showed an increase in velocity over the ascent which was most marked in the lower levels.

A number of successful free-rising captive-balloon ascents were made at Due West and Royal Center during the month when winds were too light for kites. The highest ascent made by this method was to an altitude of 2,991 meters at Due West on the 22d. On this date an extensive area of high pressure covered the eastern half of the country.

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during August, 1927*

TEMPERATURE (°C.)

Altitude, m. s. l. (meters)	Broken Arrow, Okla. (233 meters)		Due West, S. C. (217 meters)		Ellendale, N. Dak. (444 meters)		Groesbeck, Tex. (141 meters)		Royal Center, Ind. (225 meters)		Washington, D. C.* (7 meters)	
	Mean	Departure from 10-year mean	Mean	Departure from 7-year mean	Mean	Departure from 10-year mean	Mean	Departure from 9-year mean	Mean	Departure from 10-year mean	Mean	Departure from 3-year mean
Surface	23.5	−3.2	25.1	−0.9	17.7	−2.5	26.5	−0.4	21.2	−2.4	25.1	+0.7
250	23.4	−3.2	24.8	−0.8	------	------	25.8	−0.2	21.0	−2.4	23.1	−0.2
500	22.0	−3.2	22.7	−0.4	17.7	−2.4	24.6	+0.3	19.5	−1.8	21.2	−1.1
750	21.2	−2.8	21.1	−0.3	17.2	−2.0	24.0	+0.7	18.0	−1.6	19.7	−1.3
1,000	20.5	−2.3	20.1	+0.2	16.1	−2.0	22.9	+0.7	16.4	−1.6	18.3	−1.4
1,250	19.4	−1.9	18.9	+0.5	14.6	−2.2	21.5	+0.6	14.8	−1.7	16.8	−1.4
1,500	18.1	−1.6	17.4	+0.5	13.0	−2.4	19.9	+0.4	13.4	−1.7	15.3	−1.3
2,000	15.1	−1.2	14.8	+0.7	9.9	−2.6	16.8	+0.2	9.8	−2.5	12.4	−1.4
2,500	12.2	−0.7	12.2	+1.1	6.7	−2.8	13.5	−0.2	7.3	−2.4	9.8	−1.2
3,000	8.8	−0.9	10.3	+1.9	3.5	−3.0	10.3	−0.7	4.3	−2.6	6.4	−1.6
3,500	5.7	−0.7	8.7	+3.0	1.0	−2.6	7.3	−1.2	1.2	−3.0	------	------
4,000	3.2	−0.3	7.4	+4.5	−1.4	−2.2	5.7	−0.4	−1.4	−3.1	------	------
4,500	0.1	−0.2	6.0	+5.2	−4.4	−2.2	------	------	−3.5	−3.1	------	------
5,000	−2.9	−0.3	5.7	+5.9	−8.6	−3.7	------	------	−6.6	−3.1	------	------

RELATIVE HUMIDITY (%)

Altitude, m. s. l. (meters)	Broken Arrow Mean	Departure	Due West Mean	Departure	Ellendale Mean	Departure	Groesbeck Mean	Departure	Royal Center Mean	Departure	Washington Mean	Departure
Surface	77	+10	67	−1	73	+7	72	−1	65	−1	67	−7
250	77	+10	68	0	------	------	72	−2	65	−1	68	−4
500	74	+10	72	+1	71	+7	69	−5	60	−5	68	−2
750	68	+6	73	+1	65	+5	61	−7	60	−6	66	−2
1,000	66	+5	72	0	64	+6	58	−5	59	−8	64	−3
1,250	67	+6	72	0	66	+9	59	−2	58	−9	64	−3
1,500	67	+6	75	+4	68	+11	60	−1	60	−6	68	−1
2,000	66	+4	76	+8	67	+12	58	−2	64	+1	67	−2
2,500	66	+4	77	+9	70	+16	59	0	55	−2	62	−4
3,000	73	+11	71	+4	72	+19	58	+2	59	+6	59	−1
3,500	75	+13	78	+9	65	+15	52	+3	59	+10	------	------
4,000	59	+1	79	+9	49	+1	------	------	50	+2	------	------
4,500	55	−1	87	+15	47	0	------	------	50	0	------	------
5,000	43	−7	50	+1	44	0	------	------	46	0	------	------

VAPOR PRESSURE (mb.)

Altitude, m. s. l. (meters)	Broken Arrow Mean	Departure	Due West Mean	Departure	Ellendale Mean	Departure	Groesbeck Mean	Departure	Royal Center Mean	Departure	Washington Mean	Departure
Surface	22.57	−0.21	21.29	−1.17	14.63	−0.41	24.42	−0.84	16.27	−2.84	21.74	−1.19
250	22.33	−0.27	21.11	−1.03	------	------	23.57	−0.89	16.06	−2.84	19.92	−1.01
500	19.82	−0.43	19.48	−0.43	14.20	−0.47	21.06	−1.09	13.76	−2.91	17.79	−1.43
750	17.49	−0.72	18.08	−0.17	12.66	−0.38	17.60	−1.54	12.50	−2.75	15.79	−1.50
1,000	16.15	−0.47	16.90	+0.16	11.61	−0.19	15.77	−0.85	11.07	−2.98	14.17	−1.49
1,250	15.02	−0.16	15.85	+0.56	10.89	+0.14	14.65	−0.29	9.84	−2.95	12.94	−1.40
1,500	13.77	−0.01	15.07	+1.29	10.11	+0.33	13.49	−0.16	9.21	−2.28	12.35	−0.97
2,000	11.46	+0.03	12.89	+1.95	8.26	+0.37	10.66	−0.56	7.86	−1.17	9.79	−1.30
2,500	9.65	+0.47	10.94	+1.98	6.98	+0.55	8.85	−0.38	5.78	−1.03	7.28	−1.43
3,000	8.59	+1.25	8.99	+1.69	5.85	+0.56	7.27	−0.21	4.90	−0.29	5.05	−1.23
3,500	6.97	+1.22	8.85	+2.61	4.54	+0.29	6.29	+0.48	3.95	−0.02	------	------
4,000	4.46	+0.24	8.23	+2.87	3.03	−0.42	------	------	2.88	−0.45	------	------
4,500	3.26	+0.17	8.17	+3.26	2.32	−0.47	------	------	2.48	−0.21	------	------
5,000	2.00	+0.07	4.68	+2.05	0.98	−1.15	------	------	1.87	−0.21	------	------

*Naval Air Station, Anacostia, D. C.

TABLE 2.—*Free-air resultant winds (m. p. s.) during August, 1927*

Altitude m. s. l. (meters)	Broken Arrow, Okla. (233 meters)				Due West, S. C. (217 meters)				Ellendale, N. Dak. (444 meters)			
	Mean		10-year mean		Mean		7-year mean		Mean		10-year mean	
	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.
Surface	S. 54°E.	2.5	S. 2°E.	3.2	N. 53°W.	1.0	N. 70°W.	0.3	S. 7°W.	1.1	S. 20°W.	0.9
250	S. 53°E.	2.5	S. 2°E.	3.4	N. 53°W.	1.0	N. 75°W.	0.4	------	------	------	------
500	S. 30°E.	2.4	S. 11°W.	4.9	N. 68°W.	1.8	N. 69°W.	0.9	S. 4°E.	1.5	S. 18°W.	1.3
750	S. 12°W.	2.4	S. 19°W.	5.4	N. 66°W.	1.8	N. 73°W.	1.0	S. 16°W.	2.5	S. 23°W.	2.5
1,000	S. 25°W.	2.9	S. 27°W.	5.7	S. 86°W.	2.7	N. 81°W.	1.3	S. 22°W.	3.2	S. 37°W.	2.6
1,250	S. 56°W.	3.3	S. 33°W.	5.5	S. 79°W.	3.8	N. 83°W.	1.8	S. 29°W.	2.9	S. 49°W.	2.9
1,500	S. 62°W.	4.7	S. 41°W.	5.5	S. 77°W.	6.0	N. 88°W.	2.7	S. 49°W.	2.9	S. 60°W.	3.5
2,000	S. 85°W.	6.6	S. 50°W.	5.0	S. 81°W.	6.6	N. 85°W.	3.7	S. 65°W.	2.9	S. 75°W.	4.6
2,500	N. 81°W.	7.6	S. 54°W.	5.1	S. 81°W.	9.7	N. 86°W.	4.8	S. 81°W.	5.1	S. 86°W.	8.2
3,000	N. 78°W.	8.8	S. 56°W.	5.4	S. 78°W.	12.4	W.	6.3	N. 88°W.	8.0	W.	8.7
3,500	N. 81°W.	9.7	S. 52°W.	6.7	S. 77°W.	13.4	S. 84°W.	9.0	N. 74°W.	12.2	N. 84°W.	11.4
4,000	N. 80°W.	10.7	S. 63°W.	7.7	S. 78°W.	13.1	S. 85°W.	9.9	N. 79°W.	14.3	N. 82°W.	11.9
4,500	N. 72°W.	14.2	S. 82°W.	8.4	S. 75°W.	14.8	S. 86°W.	12.1	N. 80°W.	14.5	N. 84°W.	12.5
5,000	N. 69°W.	11.8	N. 82°W.	12.2	S. 68°W.	16.0	S. 72°W.	15.0	S. 88°W.	14.5	N. 84°W.	13.4

Altitude m. s. l. (meters)	Groesbeck, Tex. (141 meters)				Royal Center, Ind. (225 meters)				Washington, D. C. (34 meters)			
	Mean		9-year mean		Mean		10-year mean		Mean		7-year mean	
	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.
Surface	S. 29°W.	3.8	S. 17°W.	3.1	S. 45°E.	0.2	S. 55°E.	1.2	N. 6°W.	1.0	N. 32°W.	0.5
250	S. 31°W.	5.4	S. 18°W.	4.2	------	0.4	S. 56°W.	1.5	N. 43°W.	1.9	N. 52°W.	1.1
500	S. 32°W.	7.5	S. 23°W.	5.9	S. 76°W.	1.3	S. 64°W.	3.0	N. 15°W.	2.3	N. 50°W.	1.9
750	S. 31°W.	7.3	S. 22°W.	6.1	S. 86°W.	1.8	S. 71°W.	4.0	N. 32°W.	1.9	N. 51°W.	2.3
1,000	S. 31°W.	6.5	S. 21°W.	6.0	N. 88°W.	1.7	S. 78°W.	4.9	N. 54°W.	2.0	N. 58°W.	2.8
1,250	S. 30°W.	5.0	S. 20°W.	5.4	N. 70°W.	1.8	S. 83°W.	5.4	------	------	------	------
1,500	S. 34°W.	4.0	S. 19°W.	4.7	N. 66°W.	2.0	S. 88°W.	6.2	N. 55°W.	4.3	N. 61°W.	4.2
2,000	S. 42°W.	3.1	S. 12°W.	3.7	N. 67°W.	3.2	W.	7.2	N. 72°W.	5.6	N. 65°W.	4.9
2,500	S. 58°W.	2.3	S. 13°W.	3.6	N. 78°W.	3.8	N. 86°W.	8.5	N. 77°W.	8.0	N. 71°W.	5.9
3,000	N. 68°W.	3.3	S. 20°W.	3.4	N. 86°W.	4.3	N. 84°W.	10.0	N. 82°W.	10.3	N. 73°W.	7.1
3,500	N. 36°W.	11.8	S. 27°W.	4.0	S. 89°W.	9.6	N. 84°W.	11.2	N. 58°W.	13.3	N. 73°W.	7.6
4,000	N. 37°W.	10.8	S. 50°W.	2.5	W.	10.1	N. 85°W.	12.3	N. 48°W.	12.1	N. 71°W.	7.8
4,500	N. 45°W.	14.0	S. 21°W.	1.1	W.	12.0	N. 82°W.	13.1	N. 89°W.	11.5	N. 74°W.	7.5
5,000	------	------	------	------	W.	13.0	W.	13.0	S. 38°W.	20.0	N. 70°W.	6.9

WEATHER IN THE UNITED STATES

GENERAL CONDITIONS

The outstanding feature of the month was the depression of the temperature as shown on Chart III of this REVIEW; precipitation was irregularly distributed. (See the inset on Chart IV.) Following the excessive rains of earlier months of the year drought prevailed in many localities.—*A. J. H.*

CYCLONES AND ANTICYCLONES

The tracks of 8 high-pressure and 14 low-pressure areas were plotted for the month of August. Low-pressure troughs lay over the Southern States or along the southern Atlantic coast during about 45 observation periods out of a possible 62 for the month. This pressure distribution was attended by cool weather to the North and East.

There was one hurricane, a major disturbance from the time it was first observed on the 21st, northeast of the Leeward Islands, until it passed over Iceland on the 27th.—*W. P. Day.*

THE WEATHER ELEMENTS

By P. C. DAY

PRESSURE AND WINDS

The outstanding feature of the weather for August, 1927, was the persistent coolness that existed throughout nearly the entire month over all portions of the country from the Plateau and Rocky Mountain districts eastward to the Atlantic coast, save in southern Florida and from southern Alabama westward to eastern New Mexico.

Generally speaking, there were no important fluctuations in the atmospheric pressure, the cyclones in particular being weak, often poorly defined and mainly without definite course over important length of paths. However, important precipitation occurred over extensive areas and in some locations rains were unusually frequent.

Precipitation was comparatively heavy along the entire Atlantic coast on the first two days and scattered showers prevailed on these dates also in the Plains States, some heavy amounts being received in Oklahoma and the western portions of Kansas and Nebraska. During the 3d showers continued over the middle Plains and extended eastward into the middle Mississippi and lower Ohio Valleys, local heavy falls occurring in eastern Kansas and western Missouri. On the following day the rain area extended into the Middle and South Atlantic States, though the falls were mainly light.

During the latter part of the first week only scattered showers were reported, but by the morning of the 8th a rather extensive area of precipitation had overspread portions of the middle Plains and thence eastward to the Ohio Valley and lower Lake region, with local heavy falls at wide distances. During the following 24 hours the rain area extended eastward to the Atlantic coast with heavy falls over much of the area from Maryland and West Virginia to New England.

Only local showers occurred from the 10th to 14th, but on the morning of the latter date some heavy amounts were measured in the middle Mississippi and lower Ohio Valleys and during the following 24 hours the rain area extended to the North Atlantic coast, and heavy falls were again reported from numerous points in New England and to the southward as far as Maryland. At the same time considerable precipitation occurred in the northern Rocky Mountain and near-by States, advancing during the 16th into the northern Plains and during the following day overspreading the upper and middle Mississippi Valley where a few heavy falls were measured. This rain area extended eastward during the 18th and 19th over the Atlantic Coast States from southern New England to Florida, though the falls were mainly light.

The first half of the last decade had only local showers at wide intervals of both time and space, though on the 23d and 24th the near approach of a tropical hurricane to the middle and north Atlantic coast gave some heavy rains over near-by areas from the Carolinas to New England, and at the same time local showers occurred from the middle Plains northeastward to the Great Lakes.

The last half of the third decade was mainly without important precipitation, save over the Northeastern States from the 27th to the 30th and locally in the western mountains about the same time.

Few of the rain areas referred to above were associated with more than slight depressions of the barometer, and such important winds as occurred were mainly associated with thunderstorms.

Anticyclones were in the main not important as to their individual occurrences, but they persisted to an unusual extent over the region of the Great Lakes, and low-pressure areas moving from the Rocky Mountain regions were forced to more southerly tracks than usual in their eastward movement, thus giving frequent and locally heavy rains in the regions westward and southwestward of the important high-pressure area, while over the anticyclonic area the precipitation was deficient. Anticyclonic conditions persisted throughout the month over the western coast districts and no important cyclone entered the country from that region.

The average sea-level barometric pressures were highest over the Great Lakes and upper Mississippi Valley, and lowest in the far Southwest and they were above normal in all portions save over the South Atlantic States, and locally in the far Northwest. The excesses were quite large from the Great Lakes to the Rocky Mountains, but elsewhere the departures were mainly small.

The prevailing winds were from northerly points over the Great Lakes, portions of the Ohio and Mississippi Valleys, and locally in the east Gulf and Middle Atlantic States. They were mainly from southerly points in the Great Plains and Northeastern States, and mostly variable in the remaining sections, as shown on Chart VI.

The usual details concerning the more important storms of the month appear in the table at the end of this section.

TEMPERATURE

As stated previously, the notable feature of the weather was the wide area from the Plateau and mountain regions eastward over which the average temperature was below normal, and the unusual extent of the individual negative departures over large areas in the central and northern districts.

The daily temperatures throughout were remarkably uniform, no change equal to 20° occurring in the 24-hour

periods between observations, but the daily and weekly temperatures remained almost constantly below normal over much of the area referred to, with resultant monthly means the lowest of record for August over many sections of the middle and northern districts from Michigan, Indiana, and Kentucky eastward, and at a few points further west. On the whole, however, August, 1915, appears to have been equally cold over much of the same territory and somewhat colder in the middle portions of the Mississippi Valley and Great Plains. Furthermore, the low temperatures of August, 1915, were confined largely to the latter part of the month, the last week particularly having the lowest averages ever known for the season of the year over the central valleys and Great Lakes region with individual minimum temperatures on the last day from 3° to nearly 10° lower than ever before recorded in August over a large area from the Great Lakes southwest to Texas. During August, 1927, the cold was more uniformly distributed through the month, with few if any temperatures as low as those recorded at the end of August, 1915.

While unusual coolness prevailed from the Rocky Mountains eastward, reverse conditions ruled over the Far West, and in the more northern portions a long period of heat, beginning with the last decade of July, was not terminated until near the end of the first decade of August, making a period of about 20 days of continued heat not previously exceeded for length of time in that region. After a short respite warm weather again set in over that area and the period from the 14th to 18th brought some of the highest temperatures of the month.

The warmest periods of the month were during the first few days over the more southern districts from New Mexico eastward; about the 5th to 9th over most districts from the Great Plains eastward, except as indicated above; and on the 10th over the far Southwest and the Plateau region. A maximum temperature of 118°, recorded at Yuma, Ariz., on that date, was the highest observed in August during the entire period of observations at that place.

The lowest temperatures occurred mainly during the middle of the last decade, though in a few States they were observed as early as the 9th or 10th, and considerable areas in the far Northwest had the lowest readings on the 30th or 31st.

Freezing temperatures or slightly lower occurred locally in practically all the northern border States and in the higher elevations of the mountain and Plateau regions. Frosts occurred locally in some of the more northern States and at the high elevations in some of the mountain districts. They occurred at a few points from North Dakota to Michigan on the 1st and 2d, though mainly light except at points in western Michigan where considerable damage was reported. They also occurred on the 23d and 24th over much of the same territory with considerable damage in northern Minnesota.

PRECIPITATION

Precipitation was largely excessive and of frequent occurence in Kansas and portions of near-by States, and it was generally above normal in the States from the Mississippi River westward, save in Louisiana, Texas, Iowa, and Minnesota in the more eastern sections, and Colorado, Nevada, and Oregon in the far West. There was a general excess over the Atlantic Coast States from North Carolina to New England, with some excessive amounts in the more northern districts. In portions of the Southwest, notably in Arizona and parts of Colorado and Utah, the precipitation was well distributed and frequently much above normal.

Precipitation was deficient in the Great Lakes region, the Ohio and upper Mississippi Valleys, and over the Southern States from Texas eastward. The month was unusually dry in the Great Lakes region, Michigan and Wisconsin having the least precipitation of record for August, save in 1894, and serious drought existed at the end of the month in portions of those and other near-by States. Drought more or less severe existed over much of Texas, the State total being the least of record for August save in 1899 and 1902, and in some localities the amounts were the least of record for the month.

RELATIVE HUMIDITY

Despite the comparative coolness and the tendency to higher humidity under such conditions, the percentages of relative humidity clearly outlined the areas of drought, as shown by the departures from the normal which were far below in the Great Lakes and near-by regions and in southern districts from New Mexico eastward. Over the central and northern plains and to the west and southwest to the Plateau region the percentages of relative humidity were decidedly high, in conjunction with above-normal precipitation over much of the region, despite the general coolness that prevailed. Relative humidity was high in the northeast sections also where cool weather persisted so constantly and precipitation was above normal.

SEVERE LOCAL STORMS, AUGUST, 1927

[The table herewith contains such data as have been received concerning severe local storms that occurred during the month. A more complete statement will appear in the Annual Report of the Chief of Bureau]

Place	Date	Time	Width of path, yards [1]	Loss of life	Value of property destroyed	Character of storm	Remarks	Authority
Westchester County, N. Y.	1					Severe thunderstorm.	Cellars, basements, and streets flooded	Official, U. S. Weather Bureau.
Bickleton, Wash. (near)	2		3,520		$3,000	Hail	Considerable injury to crops	Do.
Kenton, Okla. (near)	3	7-9 p. m.	2,640		2,000	do	Some poultry killed, windows broken, roofs riddled, crops damaged; path 10 miles long.	Do.
Door County, Wis	4	2-4:30 p. m.	2,640		4,000	Heavy hail	Damage principally to crops	Do.
Antelope County, Nebr	4	3 p. m.	2,640			do	Crops damaged over path 9 miles long	Do.
O'Neill, Nebr	5	2 p. m.			2,000	Hail	Windows, roofs, and gardens damaged	Do.
Emmet County, Iowa	5	4 p. m.	3 mi			do	Severe damage to crops over path 6 miles long	Do.
Polk County, Nebr. (central).	5	6:30 p. m.	5 mi		50,000	Hail and wind	Corn damaged 50 to 100 per cent in places; a few barns, windmills, and sheds damaged.	Do.
Connecticut (north central).	5	P. m.		2	365,000	Electrical and hail	Heavy damage to tobacco	Hartford Courant (Conn.).
Fairbury, Nebr	5	P. m.				Hail and rain	Corn crop on 10 farms more or less ruined; orchards and gardens damaged; poultry and pigs drowned.	Official, U. S. Weather Bureau.
Phillips and Blaine Counties, Mont.	5-6				100,000	Hail	Heavy damage to standing grain	Do.
Dawson, N. Mex	6	2 p. m.	880			Heavy hail	Character of damage not reported	Do.
Macon County, Ill	6	2:30 p. m.	3,520			do	Some fields of corn completely ruined, oats injured, windmills and light buildings damaged.	Do.
Sullivan, Ill. (near)	6	3 p. m.	3 mi		95,000	Hail	Much corn a total loss; minor property damage	Do.
De Witt County, Ill	6				6,000	Wind	Trees and buildings damaged	Do.
Steuben County, Ind	7	3-5 p. m.	220		3,000	Hail, rain, and wind.	Corn badly injured; buildings damaged; path 1 mile long.	Do.
Marathon, N. Y. (near)	7	3:30-4:15 p. m.	1,760		100,000	Heavy hail	All crops severely damaged over path 10 miles long.	Do.
Fort Robinson, Nebr	7	4:30 p. m.	8 mi		250,000	Hail	Complete destruction of crops in many places; minor property damage.	Do.
Glendo, Wyo	7		6 mi		8,000	Hail and wind	Crops hurt over path 8 miles long	Do.
Green Lane, Pa	8	10 a. m.	1,760		5,000	Electrical and hail	Orchards considerably damaged; 1 building unroofed, trees uprooted.	Do.
West Berlin and Pine Valley, N. J.	8					Tornadic wind and rain.	Many buildings damaged, some totally wrecked, wires blown down, crops and fruit injured; several persons hurt.	Do. New York Times.
New York City, N. Y., and vicinity.	8-9				1,000,000	Electrical, rain, and wind.	Several buildings wrecked, many damaged, and more than 100 cellars flooded; traffic delayed; about 20 persons injured.	Herald Tribune (New York). Official, U. S. Weather Bureau.
Sheridan, Wyo., and vicinity.	9				62,000	Heavy hail	Extensive damage to buildings and crops; path 50 miles long.	Do.
Manassa, Colo	9	Noon	4 mi		50,000	do	Barley, oat, and pea crops total loss	Do.
Shelby County, Iowa	10	6 p. m.			68,000	do	Crops damaged 50 per cent	Do.
Keya Paha County, Nebr.	10	7 p. m.			10,000	Hail	Severe crop damage over 40 square miles	Do.
Sheridan County, Wyo. (northern).	10					Hail and wind	Crops reported damaged over path 18 miles long	Do.
Colfax, Dodge, and Saunders Counties, Nebr.	11	3 p. m.	3 mi		105,000	Hail	Considerable damage to crops and gardens in places; roofs and windows damaged.	Do.
Penrose, Colo	11	3 p. m.	880			Heavy hail	50 acres of fruit injured	Do.
Rawlins and Thomas Counties, Kans.	11	3:30 p. m.	1,760		10,000	do	Chief damage to corn and field crops	Do.
Saline, Gage, and Jefferson Counties, Nebr.	11	5 p. m.	4-5 mi		20,000	Hail and wind	Damage chiefly to crops	Do.
Logan, Thomas, and Gove Counties, Kans.	11	6 p. m.	4 mi		250,000	Severe hail	Extensive crop damage	Do.
Price, Utah (near)	11		880		2,500	Hail	Sugar beets and standing grain damaged	Do.
Wheatland, Wyo	11				12,000	Heavy hail	Crop damaged	Do.
Gordon, Nebr	12	4 p. m.	880			Hail	Crops damaged 50 to 80 per cent over path 3 miles long.	Do.
Decatur County, Kans	12	5 p. m.	4 mi		10,000	do	Crops beaten; cattle injured; path 12 miles long	Do.
Butler County, Kans	12					Wind, rain, and hail.	Considerable damage to growing crops, buildings, oil-field property, highways, and communication lines; traffic crippled.	Wichita Eagle (Kans.).
Norton County, Kans	13	2-3 p. m.	1,760			Heavy hail	Extensive crop losses over path 16 miles long	Official, U. S. Weather Bureau.
Deerfield, Kans. (near)	13	4 p. m.	4 mi			Heavy hail	Crops extensively damaged	Do.
Pratt and Barber Counties, Kans.	13	7 p. m.	100		10,000	Tornado	Farm home and a number of out buildings destroyed; storm path through sparsely settled community.	Do.
Windsor Locks, Conn., and vicinity.	13				100,000	Thunderstorm and hail.	150 acres of tobacco ruined; traffic delayed by washouts; barn destroyed by lightning.	Hartford Times (Conn.).
Rugh Ranch, Colo	14	12:30 p. m.	4 mi			Heavy hail	Gardens, alfalfa, and pastures damaged	Official, U. S. Weather Bureau.
Carrabelle, Fla. (eastern part)	15	2:15 p. m.			55,000	Tornadic wind	13 business houses blown down or damaged; many residences also damaged; 8 persons injured.	Do.
Banner, Kimball, and Cheyenne Counties, Nebr.	16	2 p. m.	3,520		200,000	Hail	Severe injury to crops, buildings damaged; poultry killed; path 30 miles long.	Do.
Jeffersonville, N. Y. (near)	18	2 p. m.				Heavy hail	Corn considerably damaged	Do.
Amistead, N. Mex. (near)	18	5 p. m.	2,640		1,000	do	Character of damage not reported	Do.
Polk and Warren Counties, Iowa.	19	6:40 p. m.	1,760		20,000	Hail	do	Do.
Del Norte, Colo. (near)	20	P. m.	1,760			do	Lettuce and pea crops damaged	Do.
Fort Stanton, N. Mex	20	4:30 p. m.	1,760		2,000	Hail	Range grass badly beaten	Do.
Scott County, Kans	21	3-4 p. m.	3,520		100,000	Heavy hail	Character of damage not reported; path 30 miles long.	Do.
Webster, Nuckolls, Clay, Fillmore, Hamilton, and Merrick Counties, Nebr.	21	3-6:30 p. m.			125,000	Hail	Severe damage to crops in scattered localities over an area of 500 square miles; windows broken; poultry killed.	Do.
Smith and Osborne Counties, Kans.	21	5 p. m.	1-6 mi		75,000	Heavy hail	Character of damage not reported; drifts of hail 3 feet deep.	Do.
Rooks County, Kans	21	7:30 p. m.	10 mi		60,000	do	Heavy property damage in eastern third of county.	Do.
Cerro Gordo and Sioux Counties, Iowa.	21					Wind and hail	Buildings, telephone wires, and crops damaged	Do.
Smith County, Kans	22	4 p. m.	1,320		50,000	Heavy hail	Damage chiefly to growing crops	Do.

[1] Mi. signifies miles instead of yards.

SEVERE LOCAL STORMS, AUGUST, 1927—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks	Authority
Casper County, Wyo	22	2:45 p. m.			$12,000	Heavy hail	Windows, roofs, and auto tops pierced; crops injured.	Official, U. S. Weather Bureau.
Gordon, Ohio (1½ miles east of).	23	P. m.				Tornado	Buildings, crops, and trees damaged	Do.
Savannah, Ga	25	4 p. m.				Wind and rain	Buildings damaged; streets flooded; 2 persons injured.	Morning News (Savannah, Ga.).
Twodot, Mont	25					Hail	Serious local damage to grain and hay	Official U. S. Weather Bureau.
Salt Lake City, Utah	26	1 p. m.				do	Considerable damage in business and residential sections.	Do.
Tonasket, Wash	27	5-6 p. m.	880		3,000	do	Some crop loss	Do.
Cibecue, Ariz	28	7:15 p. m.				Heavy hail	Melon and cucumber vines ruined; tomatoes hurt; corn damaged.	Do.
Hancock County, Iowa	28	P. m.				do	Storm very destructive to crops	Do.
Palmetto, Ga	29	4:30 p. m.			10,000	do	Cotton and corn stripped	Do.
Altamont, N. Y	29	P. m.	4 mi		50,000	do	Crop and property damage over path 8 miles long.	Do.
Amistad, N. Mex. (near)	30	5-6 p. m.	3,520		3,000	do	Beans and row crops destroyed	Do.
Beaverhead County, Mont.	30					do	Storm covered wide area damaging dry lands wheat fields.	Do.
Orange, Tex. (near)	31	2:30-3:30 p. m.	10 mi			Wind and hail	1 barn and 15 oil derricks blown down; windows broken.	Do.
Scott County, Kans	31	3:20 p. m.	1,320		10,000	Heavy hail	Character of damage not reported	Do.
Ellinwood, Kans. (near)	31					do	Many roofs riddled; screens and windows broken; crops injured.	Do.

STORMS AND WEATHER WARNINGS

WASHINGTON FORECAST DISTRICT

The first tropical disturbance of the season made its appearance on the morning of the 21st, about 300 miles northeast of St. Kitts. At that time it was of considerable intensity, as indicated by the heavy northeast swells reported by the S. S. *Inanda* in approximate latitude 19° N. and longitude 60° W. Undoubtedly this disturbance developed far to the eastward, very likely in the region of the Cape Verde Islands. A letter from Capt. F. C. Seibert of the S. S. *Seekonk* reports that at 5:40 p. m., in latitude 22° 46′, longitude 63° 00′, a barometric pressure of 28.38 inches and winds of hurricane force shifting from northeast to east-southeast. A delayed report from the S. S. *Maraval* at 1 a. m., August 22, in latitude 22° 48′, longitude 65° 48′, gives lowest barometer 28.06 inches and wind calm. It moved northwestward during the next two days, at a rate of about 600 miles per day (25 m. p. h.). On the morning of the 23d its center was at latitude 31½° N., longitude 73° W. During the preceding 12 hours it had begun to recurve to the northward. By the evening of the 23d it was central about 100 miles east of Cape Hatteras, being attended by winds of hurricane force near its center. It continued to move north-northeast, passing 100 miles or less to the east of Nantucket during the daylight hours of the 24th to the Straits of Belle Isle by the morning of the 25th, attended by gales over the Canadian Maritime Provinces approximating hurricane force near the center. It then moved rapidly northeast, being central over Iceland on the morning of the 27th with air pressure 28.44 inches and attended by gales. This hurricane moved at a rate considerably in excess of the normal and slowed up very little at the time of recurve, the trajectory being very smooth and not showing a sharp bend, as in the case of storms that are slow at the recurve.

Timely advices were issued twice daily or more to coast stations and to vessels by radio. The disturbance was of major intensity and hurricane winds were experienced near the center. Although advices were timely and accurate, considerable damage resulted to shipping off the New England coast and in the region of the Canadian Maritime Provinces.

On the morning of the 27th, storm warnings were ordered from Eastport to New York in connection with relatively low pressure south of Nantucket and high pressure over the Canadian Maritime Provinces, but winds did not reach dangerous proportions.

Small craft warnings were issued on the 9th, 15th, 18th, and 26th.

Frost warnings were not ordered or required.—*R. H. Weightman.*

CHICAGO FORECAST DISTRICT

Storm warnings.—The month was marked by an unusual freedom from storms on the Great Lakes. Only two warnings of any character were issued, namely, small craft warnings on the 1st for the upper Lakes, except the Duluth section, and similar warnings on the 22d for all the upper Lakes.

Frost warnings.—These were issued as follows: On the 8th for low ground in northern Minnesota and extreme eastern North Dakota, also on the 22d for almost the same area; and on the 23d for most of Wisconsin and Michigan, northeastern Minnesota, and north-central Iowa. In addition, warnings were sent to the cranberry sections of Wisconsin on the 1st, 8th, 18th, 19th, 20th, 22d, 24th, and 25th. In most cases the frost occurred as forecast.—*C. A. Donnel.*

NEW ORLEANS FORECAST DISTRICT

Moderate weather conditions prevailed over the district during the month of August. No storm warnings were ordered and no general storm winds occurred.—*I. M. Cline.*

DENVER FORECAST DISTRICT

There was considerably more than normal activity, both in weather and temperature. There was not a single weather map, morning or evening, during the month that did not show precipitation somewhere in the district, and on 15 days of the month precipitation was recorded in every State in the district. At Denver the previous record of 16 days with 0.01 inch or more precipitation, in August, 1875, was exceeded by three days.

Generally speaking, barometric activity was sluggish and irregular. With the exception of one or two disturb-

ances that moved slowly eastward along the Canadian border, no well-defined storm centers crossed the district. There was the usual summer condition of low pressures over the Southwest and the Great Basin and a persistence of high pressure over the Missouri Valley, a condition always favorable to local showers and thunderstorms over the Rocky Mountain region in the summer months. No warnings of any kind were issued or required. Daily forecasts of wind conditions were furnished for forestry interests of western Montana, but the month was not one of high fire hazard in that region.—*E. B. Gittings.*

SAN FRANCISCO FORECAST DISTRICT

The North Pacific anticyclone maintained its normal position for the season throughout most of the month, and although it showed more than normal development, the velocity and direction of the winds along its southern and eastern periphery were about normal. The settled character of the weather along the great circle route between San Francisco and Honolulu made it possible to issue definite forecasts of wind and weather for the entire course with considerable assurance during the Dole Pacific flight and later during the intensive search for the three airplanes which failed to arrive at Honolulu. On the morning of departure, August 16th, the pilot or navigator of each airplane was handed a bulletin containing a detailed forecast of wind and weather over the entire route to be covered, together with a weather chart made up from data received the same morning from ships on the Pacific. Special bulletins were issued morning and evening from the 14th to the 22d and a special forecast was made for the airplane *Dallas Spirit* just before its departure from Oakland for Honolulu on the 19th. All of these ocean airway forecasts were verified in almost every detail.

Temperatures were above normal and humidity below normal throughout most of the month in the Pacific Northwest, except for a short period near the middle of the month in Idaho. Changes in the fire hazard were gradual and no special warnings were issued, the situation being covered from day to day in the general forecasts. However, special forecasts of mountain thunderstorms were issued for southern California on several occasions. At the request of the Forest Service special forecasts were issued for several areas where severe fires were in progress.

No storm warnings were issued during the month and none were necessary. No precipitation of consequence fell in California and no rain warnings were issued.—*Floyd D. Young.*

RIVERS AND FLOODS

By R. E. SPENCER

Heavy rains in four periods during August over Kansas, Oklahoma, southern Missouri, and Arkansas caused floods of varying magnitude in the rivers of the Topeka, Wichita, Fort Smith, and Little Rock River districts. The first rain period, from August 1 to 4, was followed by moderate rises in the first three of these districts; the second period, from the 6th to the 9th, affected only the Topeka and Fort Smith districts; the third, from August 12 to 17, which was by far the most serious, caused floods in all four districts; and the effects of the fourth, from August 23 to 27, were felt only moderately in the Topeka and Wichita districts.

Topeka district.—The rains of the first period were practically without consequence; but those of August 6–8 resulted in the overflow of a considerable area of farm land in the Blue River Basin and slight damage at Oswego, Kans., on the Neosho.

During the third period, following August 12, damaging overflows occurred along the Smoky Hill, the Blue, the Cottonwood, the Neosho, and in small streams where Weather Bureau gauges are not maintained. The heaviest losses occurred at Salina, Kans., where about half the area of the city was flooded and approximately $500,000 damage was done. Losses in other portions of the Smoky Hill Valley amounted to about $40,000, and one life was lost in Lincoln County. In the Blue River Basin the combined loss for the rise of this period and that following August 6, amounted to $40,000, most of which occurred in Marshall and Washington Counties. In the Cottonwood Basin, Lyon, Chase, and Marion Counties suffered losses amounting to $65,000. At and near Council Grove, Kans., on the Neosho, $16,000 damage was done to bridges, highways, and business buildings; and further downstream, in the vicinity of Oswego, an additional $15,000 loss occurred. At and near Fort Scott, Kans., where the rains were extremely heavy, one life was lost and $206,000 damage was done. An additional $6,000 is estimated also for the overflowing of small streams in the district.

The rains following the 22d occasioned a further rise in the upper Solomon, resulting in damages estimated at $25,000.

Warnings were in the main timely and well verified.

Wichita, Little Rock, and Fort Smith districts.—In the Wichita district flood conditions followed closely each of the rainfall periods from the 2d to the 4th, after the 12th, and on the 27th, but the only one of the three having serious consequences was that following the 12th. The official in charge of the Weather Bureau office at Wichita, Kans., reports regarding this rise as follows:

> In the period from the 13th to the 22d there were floods and recurrences of floods, merging into one another with barely a separate crest at times, over the section of the Arkansas River from Great Bend to Wichita, Kans., culminating in the highest stages ever known from just below Great Bend almost to the city limits of Wichita, and equaling the highest stage previously recorded at Wichita. At Great Bend the overflow covered 100 city blocks; Hutchinson reported 100 acres of city property overflowed; in Wichita the flooded area amounted to 160 acres; and in addition to the flooded areas in the cities about 40,000 acres were overflowed in Reno County and about 27,000 in Sedgwick County. Below Wichita the flood intensity was progressively diminished so that at Arkansas City the flooding was only moderate.

The total estimate of losses for the Wichita district for August was $1,842,450, of which the greater part occurred in Barton County. The rains of the 12th and 13th in this county are reported as having been of such proportions as to result in overflow from creeks that covered some farm land to a depth of 6 feet. The value of property saved through Weather Bureau warnings was $637,000.

In the Fort Smith district on the Arkansas River, the flood stage was passed on the 6th at Webbers Falls, Okla., but the rise was practically without consequence. On the Neosho, however, a comparatively serious overflow occurred just below the Kansas line following the rains of the 12th. Approximately 3,000 acres of land were inundated near Miami, Okla., and the damage to that vicinity was estimated at $75,000. A saving of about $25,000 was affected by the flood warnings.

In the Little Rock district the White River was in flood following the 17th, and water from that stream and

the lower Arkansas, escaping through unrepaired levees, did considerable damage to farm lands. Of these overflows the official in charge of the Weather Bureau office at Little Rock reports in part as follows:

If the levees had been intact no damage of consequence would have occurred, but water began going through a number of breaks before a stage of 20 feet had been reached at Georgetown. The water flowing through these breaks inundated 100,000 acres, about one-third of which was cultivated, and most of the highways in this section were under water * * *.

With a stage of 21.6 feet at Pine Bluff, on the Arkansas River, and about 15 feet at Memphis, water ran through the breaks at Southbend, Pendleton, and Medford, inundating about 100,000 acres, one-third of which was in crops. This is the fifth time this season this area has been inundated.

It is thought that water from the White destroyed 30,000 or more acres, and that from the Arkansas at least 33,000 acres, of crops; and as the value of the crops was probably more than $10 an acre, the combined losses through these overflows amounted to at least $630,000. No lives were lost and no loss of stock was reported. Owing to the previous floods there was little else to lose.

Report on the rise in the Osage River in August has not been received.

The flood in the Illinois River, report of which was deferred from the issues of this REVIEW for June and July, will be discussed in the special report of the great Mississippi River floods of this year.

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
ATLANTIC DRAINAGE					
	Feet			*Feet*	
Neuse: Smithfield, N. C	14	26	27	15.0	27
MISSISSIPPI DRAINAGE					
Tippecanoe: Norway, Ind	6	2	2	6.0	2
Smoky Hill:					
Mentor, Kans	22	14	21	25.8	17
Solomon, Kans	24	15	23	26.8	21
Solomon: Beloit, Kans	18	3	3	20.5	3
		18	18	20.1	18
		23	26	24.5	26
Blue: Blue Rapids, Kans	20	8	9	23.6	9
		13	15	23.0	14
Osage:					
Osceola, Mo	20	8	12	27.9	10
		16	24	28.5	20
Warsaw, Mo	22	9	13	31.8	10
		18	24	25.9	21
Tuscumbia, Mo	25	10	15	30.5	13
		22	24	25.4	23
Arkansas:					
Fort Lyon, Colo	6			8.2	3
Dodge City, Kans	5	5	5	5.3	5
Great Bend, Kans	5	3	7	6.3	7
		13	13	5.8	13
		16	17	6.0	17
Wichita, Kans	9	14	22	13.5	17
Arkansas City, Kans	15	4	4	16.1	4
		17	22	17.2	20
Webbers Falls, Okla	23	6	6	23.2	6
Dardanelle, Ark	20	8	8	20.0	8
Little Arkansas: Sedgwick, Kans	18	15	17	23.2	16
		27	28	19.8	28
Neosho:					
Oswego, Kans	17	10	10	18.8	10
		15	22	22.1	18
Wyandotte, Okla	23	18	19	25.8	18
Fort Gibson, Okla	22	20	20	22.5	20
Cottonwood:					
Elmdale, Kans	32	18	18	32.5	18
Emporia, Kans	20	17	20	22.5	19
Cimarron: Perkins, Okla	11	4	4	12.2	4
Canadian: Logan, N. Mex	4			5.0	5
North Canadian:					
Woodward, Okla	4	3	6	5.1	4, 6
Oklahoma City, Okla	12	10	10	12.0	10
Petit Jean: Danville, Ark	20	11	12	20.2	11
White:					
Calico Rock, Ark	18	17	19	24.8	17
Batesville, Ark	23	18	20	29.3	19
Newport, Ark	26	19	22	27.4	21
Georgetown, Ark	22	24	24	22.0	24
Black:					
Corning, Ark	11	16	21	12.1	18
Black Rock, Ark	14	18	22	15.0	19
WEST GULF DRAINAGE					
Rio Grande:					
San Marcial, N. Mex	2			3.7	25

MEAN LAKE LEVELS DURING AUGUST, 1927

By UNITED STATES LAKE SURVEY

[Detroit, Mich., September 6, 1927]

The following data are reported in the "Notice to Mariners" of the above date:

Data	Lakes [1]			
	Superior	Michigan and Huron	Erie	Ontario
Mean level during August, 1927:	*Feet*	*Feet*	*Feet*	*Feet*
Above mean sea level at New York	602.77	579.46	572.01	245.77
Above or below—				
Mean stage of July, 1927	+0.08	−0.09	−0.15	−0.24
Mean stage of August, 1926	+1.75	+0.85	+0.71	+0.78
Average stage for August last 10 years	+0.59	−0.85	−0.30	−0.29
Highest recorded August stage	−1.16	−4.05	−2.10	−2.49
Lowest recorded August stage	+1.75	+1.02	+0.93	+1.42
Average departure (since 1860) of the August level from the July level	+0.11	−0.05	−0.18	−0.30

[1] Lake St. Clair's level: In August, 1927, 574.74 feet.

EFFECT OF WEATHER ON CROPS AND FARMING OPERATIONS, AUGUST, 1927

By J. B. KINCER

General summary.—Temperatures during the month tended to subnormal generally and retarded development of warm-weather crops considerably. During the first decade there was too frequent rain for cotton in the Southeast, while in the central Great Plains and more east-central areas beneficial showers occurred. Warm weather in southern sections promoted rapid growth, while farm work proceeded satisfactorily in more northern portions. The weather in northern areas was generally cool, but no materially harmful temperatures occurred, except that some more or less local frost damage was noted in parts of the upper western Lake region. It remained generally cool for the season in northern States east of the Rocky Mountains, but the South had warmer than normal weather.

The continuation of cool weather during the last decade east of the Rocky Mountains materially retarded warm-weather crops and higher temperatures were generally needed. Showers to generous rainfall, however, relieved the drought in some sections of the central-northern portions and in the Southwest; from western Texas westward showers were beneficial, but in other parts, including much of Texas, it continued too dry. There was considerable frost damage to tender vegetation in some parts of the Central Northern States, particularly on lowlands of Wisconsin and Minnesota, with some light frost in parts of Iowa. At the close of the month rain was still badly needed in much of Texas and also in most sections from Michigan to Minnesota, but elsewhere east of the Rocky Mountains the soil was in mostly good condition with fall plowing progressing rapidly in many places and some seeding of winter grains begun in the West. West of the Rocky Mountains conditions continued generally favorable, especially in the Pacific Northwest, though moisture was needed in some sections.

Small grains.—The threshing of winter grains made good progress under generally favorable weather the first part of the month, and in the spring wheat belt the cool, fair weather made exceptionally good conditions for harvest. Late spring wheat was badly damaged by rust in Minnesota, and there was considerable rust

development in some parts of North Dakota, but the crop in the latter State was too far advanced for serious damage. There was considerable interruption by rain to harvesting in the Rocky Mountain districts the first part of the second decade, and some unthreshed wheat in shock was rather badly damaged in parts of the Great Plains. In the spring wheat belt cutting and threshing made mostly satisfactory advance.

Toward the close of the second decade more favorable conditions for harvest prevailed and late threshing made good progress; there was some delay to harvest by rain in the spring wheat region, but this work made generally good advance. Threshing spring wheat made good progress the latter part of the month, under mostly favorable weather conditions, with only slight interruption by rainfall. Spring wheat had been mostly harvested at the close, except in some of the later districts. Plowing for fall seeding advanced rapidly with seeding well along in parts of Kansas.

Oat harvest had been completed during the first decade as far north as Iowa and in the East was well along to Pennsylvania; damage by rust was greater than anticipated in some parts of the northern plains and yields were disappointing in some interior sections. Rice harvest progressed favorably and grain sorghums were in good condition, but cool weather at the close of the month retarded maturity.

Corn.—The corn crop needed warm weather quite generally over northern portions during most of the month. The weather was too cool for best progress of the crop during the first decade over most of the main Corn Belt and generally in northern sections east of the Rocky Mountains, although it made mostly fair to very good advance. Beneficial rains occurred in some previously droughty areas and in Iowa progress was excellent where the rainfall was sufficient; in other States west of the Mississippi River growth was mostly good to excellent. Moisture conditions were quite favorable during the second decade and rains in Iowa were very beneficial; elsewhere in the West progress was again satisfactory, but rain was badly needed in some north-central border States and for late corn in the west Gulf area, as well as locally in the Southeast. Because of the continued cool weather, corn made slow progress in much of the principal producing area the latter part of the month. The crop was very late at the close and needed dry, warm weather to hasten maturity; damage by frost was reported on some lowlands of the Central Northern States. In Iowa advance of the crop was fair, but the condition varied greatly, ranging from very poor to very good, and was fully two weeks later than normal.

Cotton.—Temperatures were generally favorable in the Cotton Belt the first part of the month, but there was too much rain in most of the Atlantic Coast States, parts of the central belt, and in the Northwest. Weevil activity was favored by showers in the east, but progress of the crop was fair to very good in central portions. There were some complaints of rank growth and shedding in parts of Arkansas, and rains were unfavorable in portions of Oklahoma with condition in the eastern part of the State dependent on weevil activity. Weevil were held in check in Texas by warm days and abundant sunshine, but there was some shedding and poor development reported.

During the second decade weevil activity increased in the east and some increase was also noted in central portions where there were local complaints of bolls shedding and rotting. In Louisiana advance was poor due to shedding and increased weevil activity, but in Arkansas progress was very good, except for too rank growth in parts. Growth continued fair in Oklahoma, although weevil spread somewhat; in Texas conditions were favorable for reduced weevil activity, but there were complaints of shedding and premature opening.

Deterioration continued in some Atlantic Coast States the latter part of the month because of weevil or dryness and shedding; progress varied in central areas, but was mostly poor to only fair. Weevil continued active in Louisiana with a top crop impossible in most portions; cool, damp weather and weevil made advance very poor to only fair in parts of Arkansas, while in Oklahoma cool, cloudy weather was unfavorable with the progress of cotton ranging from deterioration in some eastern areas to good in the west. In Texas, advance was good in the northwest and portions of the west, but elsewhere there was further deterioration because of shedding, premature opening, root rot, and plants dying, with considerable damage by bollworms and weevil.

Ranges, pastures, and livestock.—Serious drought prevailed in the western upper Lake region, and at the close of the month there was need of rain over large parts of the Gulf States and in Oregon and Nevada. There was some delay to haying by showers during the month, with damage to cut hay and alfalfa quite general in the West the first part of the month. Alfalfa seed harvest continued in Arizona at the close, but in Utah most of the seed crop was late and not promising. Livestock continued in fine condition over most of the country.

Miscellaneous crops.—Except for some blight of potatoes in New York and too dry conditions in the western lake region, this crop did well generally the first part of the month, but toward the close there was some frost injury in the northern portions of North Dakota and Minnesota in fields where frost forms most readily. Truck crops were mostly satisfactory, except that they needed rain in most parts of the Gulf States and warmth in the Northeast. Rain was needed for tobacco in Kentucky as well as warmth for best progress elsewhere. Sugar cane in Louisiana did well generally and sugar beets advanced satisfactorily.

WEATHER ON THE ATLANTIC AND PACIFIC OCEANS

NORTH ATLANTIC OCEAN

By F. A. YOUNG

With the exception of the tropical hurricane that will be referred to later, the weather over the North Atlantic Ocean presented few unusual features. Gales of extra-tropical origin were reported on from two to four days over different sections of the steamer lanes, and were, for the most part, of comparatively moderate intensity.

Fog was very prevalent in the vicinity of Nantucket where it was reported on 19 days; over the Grand Banks it was somewhat less frequent than usual, and was not far from the normal over the steamer lanes and off the European coast.

TABLE 1.—*Averages, departures, and extremes of atmospheric pressure at sea level, 8 a. m. (75th meridian), North Atlantic Ocean, August, 1927*

Stations	Average pressure	Departure [1]	Highest	Date	Lowest	Date
	Inches	*Inch*	*Inches*		*Inches*	
Belle Island, Newfoundland	29.92	+0.03	30.34	15th	29.42	3d.
Halifax	30.04	+0.06	30.46	27th	29.64	2d.
Nantucket	29.99	−0.01	30.30	26th	29.64	24th.
Hatteras	29.99	−0.05	30.14	22d	29.86	18th.
Key West	29.99	+0.01	30.08	1st [2]	29.92	13th.
New Orleans	30.02	+0.05	30.12	5th	29.90	13th.[2]
Swan Island	29.87	−0.04	29.92	1st [2]	29.80	6th.
Turks Island	30.04	+0.04	30.12	1st	29.96	22d.
Bermuda	30.09	+0.04	30.32	1st	29.92	13th.
Horta, Azores	30.20	0.00	30.42	26th	29.94	22d.
Lerwick, Shetland, Islands	[3] 29.80	0.00	30.33	30th	29.35	22d.
Valencia, Ireland	[3] 29.86	−0.06	30.32	25th	29.32	7th.
London	[3] 29.90	−0.08	30.34	3d	29.48	22d.

[1] From normals shown on H. O. Pilot Chart, based on observations at Greenwich mean noon, or 7 a. m. 75th meridian.
[2] And on other dates.
[3] Mean of 29 observations; 2 days missing.

From the 1st to 5th moderate weather was the rule over the entire ocean, with the exception of moderate gales on the 2d and 5th over a limited area west of the 55th meridian, between the 35th and 45th parallels.

On the 6th favorable weather prevailed generally, except for a comparatively slight cyclonic disturbance over the eastern section of the steamer lanes, and winds of moderate gale force off the coast of Honduras, as shown by report in table.

From the 10th to 16th anticyclonic conditions were the rule, except that on the 10th a disturbance was central near 45° N., 40° W., and on the 16th southerly gales were encountered between the 40th parallel and Newfoundland.

From the 18th to 21st a well-defined area of low pressure covered an extensive area over the middle and eastern sections of the steamer lanes. This disturbance reached its greatest intensity on the 19th and 20th when moderate to strong gales occurred between the 20th and 40th meridians.

On the 21st the first tropical hurricane of the season was reported about 300 miles northeast of St. Kitts. Charts VIII to XI cover the period from the 22d to 25th, inclusive, and on Chart XI a track is drawn showing the movement of the hurricane from the 21st to 27th. Reports in the table give an idea of the violence of this storm, which was responsible for an immense amount of damage and large loss of life, especially in the Maritime Provinces of Canada and on the fishing banks. The coast of New England also suffered considerable damage, but New York escaped with winds of moderate gale force.

The position as shown on the 26th is somewhat in doubt, as few vessel reports were received from that vicinity. On the 27th with the center of this disturbance near Seydisfjord, Iceland, the storm area extended as far south as the 55th parallel, where westerly winds of force 8 were reported.

From the 28th until the end of the month low pressure continued in the vicinity of Iceland, although during this period moderate weather prevailed over the ocean as a whole.

NOTE.—British S. S. *Fort Victoria*, Capt. J. W. McKenzie, Observer J. F. Dunnett, from Bermuda to New York:

On August 3, between 11 a. m. and noon, A. T. S., approximate position 36° 50′ N., 69° 40′ W., passed five waterspouts. The last one we passed about noon, and it was about 5 miles south of us. The wind was NNW., force 3 to 4. No variation of the barometer was noticeable.

OCEAN GALES AND STORMS, AUGUST, 1927

Vessel	Voyage		Position at time of lowest barometer		Gale began	Time of lowest barometer	Gale ended	Lowest barometer (Ins.)	Direction of wind when gale began	Direction and force of wind at time of lowest barometer	Direction of wind when gale ended	Highest force of wind and direction	Shifts of wind near time of lowest barometer
	From—	To—	Latitude	Longitude									
NORTH ATLANTIC OCEAN			° ′	° ′									
Housatonic, Br. S. S.	Key West	Avonmouth	39 27N.	66 20W.	Aug. 1	10 p. 1	Aug. 2	29.84	SSW	S., 8	WSW	S., 8	SSW-WSW.
Caronia, Br. S. S.	Cherbourg	New York	41 12N.	57 00W.	5	noon, 5	5	29.77	W	SW., 8	NW	S., 9	SW-NW.
Trinculo, Br. S. S.	Rotterdam	Curacao	44 24N.	18 12W.	5	1a. 6	6	29.74	SW	WNW	NW	WNW., 8	SW-WNW.
Copan, Hond. S. S.	New Orleans	Puerto Cortes.	15 48N.	88 00W.	7	4a. 7	7	29.72	ENE	ENE	E	E., 8	Steady.
Bristol City, Br. S. S.	New York	Bristol	46 17N.	40 52W.	9	Mdt., 10	10	29.57	SSE	SSE., 8	SSE	SSE., 8	Do.
Anacortes, Am. S. S.	Boston	Cardiff	43 24N.	58 06W.	16	—, 16	16	29.70	SE	SSE., 8	NW	—, 9	SSE-NW.
Denham, Br. S. S.	Durban	Avonmouth	43 30N.	12 00W.	17	3p., 18	19	29.86	W	—, 6	WNW	—, 8	Steady.
Vincent, Am. S. S.	Havre	New York	48 12N.	33 29W.	19	5a., 19	20	29.12	S	SSW., 9	WNW	W., 9	S-W.
Stockholm, Swed. S. S.	Gothenburg	do	56 00N.	26 12W.	19	1a., 20	20	28.65	E	NE., 9	NNW	NE., 9	E-NNE.
Western Ally, Am. S. S.	Antwerp	do	50 25N.	16 00W.	19	9p., 20	22	29.25	SW	SW., 9	NW	SW., 9	Steady.
Schoharie, Am. S. S.	Liverpool	Jacksonville	47 51N.	17 50W.	20	11a., 21	22	29.20	SW	W., 9	NW	W., 9	SW-WNW.
Raimund, Ger. S. S.	Bremen	New Orleans	28 02N.	68 40W.	22	8p., 22	23	29.15	ENE	SE., 12	E	—, 12	E-SE.
Maraval, Br. S. S.	New York	West Indies	25 00N.	65 35W.	21	1a., 22	23	28.06	NE	N., 12	S	N., 12	
Maracaibo, Am. S. S.	La Guayra	New York	34 00N.	70 15W.	23	8p., 23	24	29.41	E	SE., 12	WNW	SE., 12	SE-SSE.
Cripple Creek, Am. S. S.	Port Arthur	Liverpool	36 18N.	72 45W.	23	4p., 23	24	28.66	E	E., 7	W	NW., 12	NE-NW.
Chatham, Am. S. S.	Boston	Norfolk	40 13N.	70 30W.	24	10a., 24	24	28.98	NE	ENE., 12	NW	ENE., 12	ENE-N.
Darian, Br. S. S.	Liverpool	Boston	42 20N.	67 28W.	24	4p., 24	24	28.53	N	N	NW	—, 12	NE-N.
Stockholm, Swed. S. S.	Gothenburg	New York	44 18N.	63 18W.	24	10p., 24	25	28.82	SSE	S., 12	WSW	S., 12	SSE-WSW.
Ariano, Br. S. S.	Montreal	London	52 46N.	46 19W.	25	9p., 25	26	28.81	NE	W., 8	WNW	WNW., 11	WSW-WNW.
Galtymore, Br. S. S.	Liverpool	Boston	52 09N.	35 20W.	25	2a., 26	28	29.17	S	W., 11	W	W., 11	SSW-W.
Winnebago, Br. S. S.	Manchester	New York	55 18N.	15 15W.	26	10p., 27	27	29.37	WSW	SW., 9	WSW	SW., 9	WSW-SW.
NORTH PACIFIC OCEAN													
Pres. Cleveland, Am. S. S.	Honolulu	Yokohama	41 00N.	150 00E.	7	6p., 7	8	29.62	SE	SE., 7	SE	SE., 8	Steady.
Pacific, Am. S. S.	Everett	Balboa	12 51N.	91 03W.	8	3p., 8	8	29.67	SW	SW., 8	SW	SW., 8	Do.
Standard, Am. S. S.	San Pedro	do	16 30N.	100 30W.	8	8p., 8	9	29.65	SE	SE., 9	SE	SE., 9	Do.
Nora, Am. S. S.	do	Iquique	19 36N.	106 10W.	9	2p., 9	10	29.67	SE	SE., 9	SE	SE., 9	Do.
General Smuts, Br. S. S.	Osaka	Coos Bay	47 43N.	149 42W.	11	2a., 11	11	30.00	WSW	W., 7	W	W., 8	Do.
Africa Maru, Jap. S. S.	Victoria	Yokohama	51 20N.	173 46W.	9	Noon, 11	12	29.48	SW	WSW., 8		WSW., 8	SW-NW.
West Holbrook, Am. S. S.	Columbia River.	Nagoya	43 25N.	150 54E.	13	5p., 13	13	29.48	SE	SSE., 10	SW	SSE., 10	S-SW.
Choyo Maru., Jap. S. S.	Miike	Astoria	40 36N.	150 19E.	13	Noon, 13	13	29.58	SE	SSE., 8	SSW	SSE., 8	SSE-SSW.
Absia, Du. S. S.	San Francisco	Yokohama	40 20N.	154 00W.	30	10a., 31	31	29.49	SE	SSE., 9	NW	SE., 10	SE-S-W.
Havre Maru, Jap. S. S.	Yokohama	San Francisco	39 57N.	149 50E.	30	4a., 31	31	29.20	S	S., 8	WSW	W., 9	S-W.
SOUTH PACIFIC OCEAN													
West Henshaw, Am. S. S.	Dunedin, N.Z	do	33 21S.	173 34W.	6	Noon, 7	7	29.55	N	NNW., 9	WSW	NNW., 9	
Losada, Br. S. S.	Corral	Balboa	31 48S.	72 32W.	13	Mdt., 13	14	30.00	SSE	S	S	S., 8	
Valemore, Br. S. S.	Buenos Aires	Antofagasta	41 32S.	78 36W.	13	11p., 14	15	29.59	W	WSW., 8	WSW	WSW., 11	W-WSW.
Aorangi, Br. M. S.	Honolulu	Sydney	34 12S.	161 29E.	17	4p., 17	18	29.72	SW	SW., 6	SSW	SW., 8	WNW-SW.
Tekoa, Br. S. S.	Wellington	Balboa	38 54S.	145 25W.	19	8p., 21	21	29.75	E	NNE., 7	N	NNE., 8	NNE-NNW.
SOUTH ATLANTIC OCEAN													
Valemore, Br. S. S.	Buenos Aires	Antofagasta	46 25S.	62 44W.	7	2a., 8	8	29.08	W	WSW., 10	SW	WSW., 10	W-WSW.
Elkhorn, Am. S. S.	Port Arthur	Pernambuco	31 36S.	50 14W.	12	4p., 12	14	29.36	NE	SW., 10	SW	SW., 10	NNE-SW.
Capillo, Am. S. S.	New York	Montevideo	25 10S.	43 43W.	13	2p., 13	14	29.49	SW	SW., 8	SW	SW., 8	Steady.

NORTH PACIFIC OCEAN

By WILLIS E. HURD

Good weather continued over the great sailing routes of the North Pacific Ocean during August, and gales in northern and middle latitudes were nearly as infrequent as during the quiet preceding month. Except for some moderately strong winds not exceeding 8 in force experienced south of the central Aleutians and the Gulf of Alaska on and about the 11th, the only known gales occurring north of the 40th parallel were in connection with cyclones passing up the east coast of central Japan on the 7th, 13th, and 31st. These gales were reported as rising to force 10 on the last two dates.

The great anticyclone of the eastern part of the ocean continued strong and widespread throughout the month as well as undisturbed by intruding cyclones. Pressures were moderately low over Aleutian and southwestern Alaskan waters, and generally with only slight variations from the normal. Yet the Aleutian cyclone was plainly in evidence over part or all of this area during the entire period. Pressures elsewhere likewise did not vary greatly from the average of many years. Readings for selected coast and island stations in west longitudes are given in the following table:

TABLE 1.—*Averages, departures, and extremes of atmospheric pressure at sea level at indicated hours, North Pacific Ocean, August, 1927*

Stations	Average pressure	Departure from normal	Highest	Date	Lowest	Date
	Inches	*Inch*	*Inches*		*Inches*	
Dutch Harbor [1,4]	29.78	−0.12	30.26	31st	29.20	12th.
St. Paul [1,5]	29.78	+0.02	30.24	31st	29.12	10th.
Kodiak [1,6]	29.83	−0.02	30.26	20th	29.44	11th.
Midway Island [1]	30.05	−0.04	30.14	2d	29.90	31st.
Honolulu [2]	30.01	0.00	30.08	27th	29.92	31st.
Juneau [2]	30.00	−0.02	30.35	16th	29.51	26th.
Tatoosh Island [2,3]	30.02	−0.03	30.15	30th	29.86	17th.
San Francisco [2,3]	29.97	+0.02	30.12	30th	29.78	13th.
San Diego [2,3]	29.92	+0.03	30.02	29th	29.77	8th.

[1] P. m. observations only.
[2] A. m. and p. m. observations.
[3] Corrected to 24-hour mean.
[4] For 25 days.
[5] For 29 days.
[6] For 30 days.

Considerable activity of tropical cyclones occured in the Far East. The subjoined report by Rev. José Coronas, S. J., of the Philippine Weather Bureau, narrates the movements of such typhoons as had appeared

up to and including the 26th of the month. On the two following days—the 27th and 28th—the entire southwestern part of the ocean to the coastward of the 145th meridian of east longitude was affected by cyclonic weather, although no reports are at hand as to the gales occurring near the centers of activity. On the evening of August 30 distinct typhoon centers lay close off the south coast of China, over the islands south of Kyushu, and to the eastward of Honshu.

Mexican coast waters were perturbed by a cyclone of moderate intensity which occurred on the 7th to 10th. Reports of moderate gales on the 7th and of fresh gales on the 8th were made by vessels to the south and west of the Gulf of Tehuantepec. These winds were followed by strong gales west of Manzanillo on the 9th. The wind directions noted, and the accompanying barometric depressions, further indicate that a cyclone, which seems to have died out below the entrance to the Gulf of California on the 10th, was passing up the coast.

The weather at Honolulu was not marked by exceptional conditions. The prevailing wind was east. The average wind velocity was 10 miles an hour, and the maximum velocity 28 miles from the northeast on the 2d.

Fog continued frequent during August along the northern sailing routes, the percentage being close to 30 from the central Aleutians southwestward to northern Japan, and only slightly less eastward to about 145° west longitude, but much less thence to the American coast. Considerable fog occurred, however, in the upper coast waters of Washington and off middle and southern California. Yet on the whole the percentages were somewhat lower than the normal as outlined on the Hydrographic Office Pilot Chart of the North Pacific Ocean.

TYPHOONS AND DEPRESSIONS

TYPHOONS IN THE FAR EAST DURING AUGUST, 1927

By REV. JOSÉ CORONAS, S. J.

[Weather Bureau, Manila, P. I.]

There have been at least three well-developed typhoons in the Far East during this month of August: One over the Philippines, one over Formosa, and one over the Loochoos and Korea. Three other smaller or less important typhoons were shown by our weather maps.

Typhoon over the Loochoos and Korea.—This typhoon was probably formed on August 3 to 4 about 250 miles to the north of Yap. It moved first westward for one day, and then it inclined gradually to the north on the 5th. According to our weather maps, it seems to have moved almost due N., and perhaps even to N. by E. on the 6th, but on the 7th, when near the Loochoos, it took a NW. direction, and kept this direction until about noon of the 8th, when it moved N. or N. by E. across the Eastern Sea near the China coast. On the 9th it recurved more to the NE. and traversed Korea during the night of that day.

The position of the center at 6 a. m. of the 7th, 8th, 9th, and 10th was as follows:

August 7, 6 a. m., 127° 00′ longitude E., 23° 45′ latitude N.
August 8, 6 a. m., 124° 00′ longitude E., 27° 10′ latitude N.
August 9, 6 a. m., 123° 50′ longitude E., 32° 50′ latitude N.
August 10, 6 a. m., 129° 45′ longitude E., 38° 40′ latitude N.

Typhoon of Formosa.—This typhoon was clearly shown by our weather maps in the afternoon of August 11 to the north-northwest of Yap, not far from 137° longitude E., between 13° and 14° latitude N. It moved practically to NW. by W. from the beginning until it reached the southern part of Formosa in the morning of the 15th. It traversed Formosa and the Formosa Channel on the 15th, moving WNW.

The approximate position of the center at 6 a. m. of the 12th, 13th, 14th, 15th, and 16th was as follows:

August 12, 6 a. m., 134° 00′ longitude E., 15° 10′ latitude N.
August 13, 6 a. m., 130° 15′ longitude E., 17° 15′ latitude N.
August 14, 6 a. m., 126° 05′ longitude E., 19° 35′ latitude N.
August 15, 6 a. m., 121° 55′ longitude E., 22° 10′ latitude N.
August 16, 6 a. m., 115° 30′ longitude E., 24° 45′ latitude N.

Typhoon over the northernmost part of Luzon.—This typhoon was shown by our weather maps of August 18 to the east of Luzon in about 129° longitude E., 16°, or between 16° and 17°, latitude N. It moved WNW. and passed close to Aparri in the morning of the 19th, the barometric minimum recorded there being as low as 726.49 mm. (28.60 inches) at 8.30 a. m. The center passed very near to Pratas during the night of the 19th to 20th, and about 60 miles to south of Hong Kong at about noon or 2 p. m. of the 20th. The violence of the storm was strongly felt in the Provinces of Cagayan, Mountain, Ilocos Norte, and Ilocos Sur.

The position of the center at 6 a. m. of the 18th to 20th was:

August 18, 6 a. m., 128° 50′ longitude E., 16° 20′ latitude N.
August 19, 6 a. m., 122° 15′ longitude E., 18° 30′ latitude N.
August 20, 6 a. m., 115° 40′ longitude E., 20° 35′ latitude N.

Another typhoon is being shown by our weather maps at the time we are writing these notes to the east of the northernmost part of Luzon. It appeared on August 22 about 500 miles to the east of San Bernardino Strait. It moved NW. or NNW. on the 22d and 23d; but then it remained almost stationary for about two days near 129° longitude E., between 18° and 19° latitude N. At present it seems to be inclining gradually to the west.[1]

A small typhoon of no great importance moved northward near and to the west of Meiacosima group of islands on August 2 to 4.

Finally another typhoon of no importance for the Philippines was noticed to the south of Guam on August 19 and 20. It recurved northeastward about 300 miles to the west of the Ladrone Islands on the 22d.

[1] To-day, Aug. 26, there are three or four centers of depression or typhoon shown by our weather maps over the Pacific to the east of the Philippines and the Loochoos Islands. We may mention their tracks in our article for next month.

CLIMATOLOGICAL TABLES[1]

CONDENSED CLIMATOLOGICAL SUMMARY

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

Condensed climatological summary of temperature and precipitation by sections, August, 1927

Section	Temperature								Precipitation					
	Section average	Departure from the normal	Monthly extremes						Section average	Departure from the normal	Greatest monthly		Least monthly	
			Station	Highest	Date	Station	Lowest	Date			Station	Amount	Station	Amount
	°F	°F		°F			°F		In.	In.		In.		In.
Alabama	78.5	−1.1	Brewton	100	2	Valley Head	48	20	3.56	−0.98	Tallassee	9.56	Milltown	1.00
Arizona	79.0	−0.8	4 stations	118	10	Bright Angel	28	10	2.74	+0.63	Crown King	11.50	Maricopa	0.13
Arkansas	76.6	−3.1	Texarkana	105	1	Dutton	43	21	6.01	+2.32	Higden	12.74	Whitecliffs	0.84
California	70.6	−1.1	Greenland Ranch	121	10	Portola	22	30	0.03	−0.06	Llano	1.00	142 stations	0.00
Colorado	61.5	−3.3	2 stations	97	[2] 7	3 stations	25	17	2.75	+0.64	Columbine Ranch	6.54	Norwood	0.30
Florida	81.9	+0.5	4 stations	100	[2] 4	Vernon	58	27	6.27	−0.76	Ocala	15.10	Coral Gables	1.34
Georgia	78.3	−1.1	St. George	103	4	Clayton	46	29	3.88	−1.34	Tifton	9.66	Hartwell	0.77
Idaho	65.6	−1.0	Chattins Flat	105	10	2 stations	22	31	0.72	+0.04	Dubois	2.20	Glenns Ferry	0.00
Illinois	69.1	−5.1	Morris	99	7	Mount Carroll	39	24	3.21	−0.24	Fairfield	8.48	Freeport	0.91
Indiana	67.4	−5.9	5 stations	96	7	Wheatfield	37	24	3.12	−0.19	Rockville	7.67	Thayer	1.36
Iowa	67.9	−3.8	Denison	96	6	2 stations	35	[2] 9	2.36	−1.08	Clinton	5.68	Indianola	0.67
Kansas	71.8	−5.7	2 stations	99	[2] 6	St. Francis	39	19	6.46	+3.37	Newton	14.95	Bird City	1.35
Kentucky	71.1	−4.5	Hopkinsville	97	13	Murray	43	26	2.88	−0.83	Flemingsburg	6.04	Greenville	0.74
Louisiana	81.1	−0.6	2 stations	103	[2] 15	Lake Providence	49	27	4.53	−0.66	New Orleans (No. 2)	12.05	Logansport	0.34
Maryland-Delaware	68.5	−4.8	Solomons, Md	92	7	2 stations	36	25	4.09	−0.18	Pocomoke City, Md.	6.40	Stevensville, Md	1.99
Michigan	62.4	−4.1	2 stations	94	7	Houghton Lake	27	24	0.76	−2.03	Hillsdale	3.11	Edmore	0.01
Minnesota	63.9	−2.9	Montevideo	96	31	Roseau	28	23	2.19	−0.99	Leech Lake Dam	6.80	St. Peter	0.24
Mississippi	79.0	−1.5	2 stations	101	[2] 7	Duck Hill	47	27	4.31	−0.04	Enterprise	9.09	Columbus	0.98
Missouri	71.1	−4.9	2 stations	97	[2] 6	Goodland	39	28	5.06	+1.38	Lamar	13.87	Pacific	1.94
Montana	62.5	−1.9	Frazer	98	12	Conway's ranch	23	31	2.04	+0.89	Adel	8.02	Havre	0.39
Nebraska	68.1	−4.7	3 stations	98	[2] 6	Nenzel	32	19	3.36	+0.55	Fairbury	13.13	Butte	0.78
Nevada	69.9	−1.6	Logandale	111	10	Rye Patch	21	30	0.37	−0.09	Searchlight	1.90	8 stations	0.00
New England	63.7	−3.1	Vernon, Vt	92	[2] 5	3 stations	33	26	7.15	+3.21	Fall River, Mass	13.02	Hanover, N. H	2.42
New Jersey	67.1	−4.9	4 stations	89	[2] 7	Belleplain	37	25	8.55	+3.48	Plainfield	12.87	Cape May City	2.88
New Mexico	69.9	−0.9	2 stations	104	[2] 1	2 stations	34	[2] 14	2.97	+0.50	Cloudcroft	8.69	Richland (near)	0.01
New York	63.6	−3.7	Lowville	95	8	Allegany State Park	32	[2] 3	4.64	+0.87	Setauket	13.05	2 stations	0.72
North Carolina	72.8	−2.7	Chadbourn	101	9	Mount Mitchell	38	27	5.57	+0.18	Manteo	13.32	Mount Airy	1.81
North Dakota	63.4	−2.0	New Salem	96	5	Dunseith	28	[2] 9	3.23	+0.95	Pembina	6.60	2 stations	1.25
Ohio	66.4	−5.3	Circleville	96	7	Toboso	36	25	2.50	−0.94	Jackson	6.15	Lancaster	0.64
Oklahoma	77.3	−3.7	Altus	108	[2] 8	Smithville	46	21	5.15	+1.95	Watts	13.24	Hobart	1.03
Oregon	65.6	+0.1	McMinnville	108	16	Fremont	22	[2] 14	0.37	−0.19	Astoria	2.82	5 stations	0.00
Pennsylvania	65.5	−4.5	2 stations	92	[2] 1	3 stations	34	[2] 24	4.12	−0.11	Snow Hill	11.49	Selinsgrove	1.13
South Carolina	76.1	−2.8	Santuck	99	9	Hogback Mountain	49	26	4.34	−1.45	Yemassee	8.84	Edgefield	0.45
South Dakota	67.1	−2.7	Wagner	102	6	Faith	33	18	2.28	+0.02	Deerfield	5.97	Wentworth	0.06
Tennessee	73.3	−3.1	Perryville	99	2	Waynesboro	43	26	3.84	−0.21	Kingston	8.11	Bolivar	1.32
Texas	83.6	+0.9	Fort McIntosh	111	16	Memphis	50	[2] 21	0.99	−1.57	Brooker	7.64	37 stations	0.00
Utah	67.8	−1.7	St. George	105	[2] 10	East Portal	29	17	1.24	+0.16	Hatch	3.86	Huntsville	0.00
Virginia	69.9	−4.0	Emory	95	[2] 7	Burkes Garden	35	30	4.67	+0.39	Buchanan	7.86	Mount Weather	1.53
Washington	66.1	+0.6	2 stations	104	[2] 5	Cascade Tunnel	27	30	1.47	+0.49	Snoqualmie Falls	5.70	Wapato	T.
West Virginia	67.1	−4.9	Williamson	94	7	2 stations	34	25	4.33	+0.22	Pickens	8.03	Smithfield	1.34
Wisconsin	62.8	−3.9	Prarie du Chien	98	6	Long Lake	27	24	1.17	−2.19	La Crosse	3.03	Portage	0.24
Wyoming	60.5	−3.4	Sundance	96	13	Lake Yellowstone	22	[2] 10	1.97	+0.87	Crandall Creek	4.75	Rawlins	0.07
Alaska (July)	56.8	+1.5	Porcupine Creek	95	7	Nyac	33	17	2.87	−1.13	Cordova	11.00	Hydaburg	0.40
Hawaii	74.8	+0.3	Waianae	95	27	2 stations	54	[2] 4	6.64	+0.41	Wahiawa Water Co. intake.	32.20	6 stations	0.00
Porto Rico	79.1	0.0	2 stations	98	5	Aibonito	54	16	5.84	−1.35	Maricao	16.45	Lajas Finca Julia	0.20

[1] For description of tables and charts see REVIEW, January, 1927, p. 43.

[2] Other dates also.

TABLE 1.—*Climatological data for Weather Bureau stations, August, 1927*

District and station	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Stations, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01 or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles								0-10	In.	In.
New England							64.6	−2.9										83	6.61	+2.7										6.1		
Eastport	76	67	85	29.90	29.98	+0.02	58.2	−2.5	76	2	65	48	19	51	26	55	54	90	6.53	+3.3	12	5,679	s.	30	s.	9	5	8	18	7.3	0.0	0.0
Greenville, Me.	1,070	6	----	28.84	29.99	-----	55.5	-----	79	22	70	37	26	50	33	----	----	----	5.57	-----	13	3,517	se.	24	----	24	8	7	16	----	0.0	0.0
Portland, Me.	103	82	117	29.89	30.01	+.03	63.2	−3.2	80	5	70	51	3	56	23	58	56	80	5.46	+1.9	13	5,247	s.	28	s.	9	9	9	13	5.7	0.0	0.0
Concord	289	70	79	29.68	29.99	+.01	63.6	−3.2	82	22	74	44	3	53	31	----	----	----	3.54	−0.2	13	2,702	se.	20	nw.	24	9	11	11	6.1	0.0	0.0
Burlington	403	11	48	29.54	29.97	.00	64.2	−3.7	82	7	73	46	26	55	28	----	----	----	4.36	+0.4	15	5,597	s.	33	s.	14	5	13	13	6.5	0.0	0.0
Northfield	876	12	60	-----	30.00	+.02	60.6	−2.8	81	1	72	41	3	49	34			87	5.92	+2.0	13	3,954	s.	40	ne.	12	1	26	4	6.3	0.0	0.0
Boston	125	115	188	29.86	29.99	.00	67.4	−2.5	85	31	75	54	25	60	22	61	58	75	6.73	+2.7	12	5,558	sw.	30	w.	5	10	10	11	6.0	0.0	0.0
Nantucket	12	14	90	29.98	29.99	.00	66.3	−1.5	77	2	72	54	26	61	16	62	61	87	7.79	+4.7	13	9,515	sw.	68	n.	24	11	6	14	6.3	0.0	0.0
Block Island	26	11	46	29.95	29.98	−.01	66.6	−1.9	78	8	71	55	27	62	14	63	61	86	7.33	+3.8	13	9,663	sw.	62	nw.	2	12	6	13	5.4	0.0	0.0
Providence	160	215	251	29.83	30.00	+.01	66.6	−4.4	82	2	74	52	25	59	24	61	58	77	10.88	+6.8	15	7,423	nw.	35	nw.	5	10	9	12	5.9	0.0	0.0
Hartford	159	122	----	29.84	30.01	+.02	66.6	−2.3	84	1	75	51	25	58	26	----	----	----	4.16	−0.4	14	------	s.	----	----	----	12	7	12	5.4	0.0	0.0
New Haven	106	74	153	29.88	29.99	.00	66.8	−3.5	82	9	75	51	25	59	23	62	59	79	9.98	+5.0	15	5,818	ne.	30	ne.	27	9	11	11	5.8	0.0	0.0
Middle Atlantic States							68.6	−4.6										79	5.02	+0.5										6.3		
Albany	97	102	115	29.89	29.99	+.01	67.1	−3.7	83	22	76	48	25	58	29	62	59	79	6.71	+2.8	13	4,433	s.	24	n.	24	10	12	9	5.3	0.0	0.0
Binghamton	871	10	84	29.08	30.01	+.02	64.0	−4.0	85	23	74	43	3	54	31	----	----	----	3.20	−0.2	14	3,103	e.	26	sw.	8	1	16	14	6.6	0.0	0.0
New York	314	414	454	29.67	30.00	-----	67.5	−5.6	83	1	74	53	27	61	19	62	59	77	8.05	+3.5	14	9,401	s.	54	sw.	8	7	12	12	6.5	0.0	0.0
Harrisburg	374	94	104	29.62	30.02	+.01	67.6	−5.0	85	23	76	52	25	60	25	61	58	75	2.55	−1.7	11	3,641	nw.	23	nw.	24	5	12	14	6.8	0.0	0.0
Philadelphia	114	123	182	29.89	30.02	+.01	70.2	−4.6	85	8	78	54	27	63	21	65	62	81	7.27	+2.7	13	5,676	sw.	33	ne.	26	3	12	16	6.8	0.0	0.0
Reading	325	81	98	29.66	30.00	-----	68.4	-----	84	13	77	52	25	60	24	61	58	74	3.99	−0.5	10	3,559	se.	20	nw.	1	8	15	8	6.0	0.0	0.0
Scranton	805	111	119	29.17	30.02	+.02	64.4	−5.4	83	23	74	47	25	54	29	59	56	78	4.77	+0.5	13	3,714	n.	20	w.	5	7	11	13	6.6	0.0	0.0
Atlantic City	52	37	172	29.93	29.99	−.01	68.4	−4.1	85	9	74	53	25	63	21	65	62	84	5.34	+1.0	12	10,496	s.	62	ne.	26	7	14	10	5.5	0.0	0.0
Cape May	17	13	49	-----	-----	-----	68.4	−5.0	85	9	76	50	25	60	26	65	64	89	2.88	-----	14	------	se.	----	----	----	7	9	15	----	0.0	0.0
Sandy Hook	22	10	55	29.96	29.98	-----	67.8	-----	83	5	74	55	27	62	20	63	60	79	7.30	-----	10	9,364	s.	50	ne.	27	6	12	13	6.4	0.0	0.0
Trenton	190	159	183	29.79	29.99	-----	68.0	-----	86	7	77	51	25	60	25	62	60	79	7.93	+2.6	11	6,030	n.	32	w.	8	3	14	14	7.2	0.0	0.0
Baltimore	123	100	215	29.87	30.00	−.01	71.0	−4.5	91	7	79	55	25	63	25	64	60	71	3.04	−1.2	13	5,936	n.	46	sw.	8	8	12	11	6.1	0.0	0.0
Washington	112	62	85	29.88	30.00	−.01	70.0	−5.0	90	7	79	54	25	61	29	64	61	76	3.84	−0.6	11	3,414	n.	30	nw.	1	4	11	16	7.0	0.0	0.0
Cape Henry	18	8	54	29.96	29.98	-----	73.2	-----	92	8	79	59	29	67	23	68	66	83	5.16	−0.9	13	8,959	sw.	44	ne.	26	8	9	14	6.1	0.0	0.0
Lynchburg	681	153	188	29.28	30.01	−.01	70.8	−4.8	91	7	80	51	30	62	31	64	62	79	4.27	0.0	16	3,761	e.	25	n.	1	9	11	11	5.6	0.0	0.0
Norfolk	91	170	205	29.90	30.00	.00	73.7	−3.7	89	8	81	59	29	67	22	67	65	79	3.85	−2.1	13	7,924	ne.	44	w.	1	7	9	15	6.5	0.0	0.0
Richmond	144	11	52	29.86	30.01	.00	71.3	−5.2	90	7	80	55	30	63	28	66	63	82	7.19	+2.8	12	4,564	ne.	25	nw.	31	9	11	11	5.9	0.0	0.0
Wytheville	2,304	49	55	27.69	30.01	−.00	66.4	−4.1	86	7	76	46	30	57	32	61	59	84	3.24	−1.3	11	2,848	w.	19	sw.	8	6	13	12	6.1	0.0	0.0
South Atlantic States							76.5	−1.6										81	5.10	−1.0										6.1		
Asheville	2,253	70	84	27.70	29.99	−.03	69.1	−1.4	88	8	78	48	29	60	25	62	60	82	2.76	−1.8	16	4,470	se.	26	se.	27	7	17	7	5.7	0.0	0.0
Charlotte	779	55	62	29.18	30.00	−.02	74.8	−2.3	96	7	84	56	29	66	25	67	64	77	3.02	−2.5	14	2,755	ne.	31	nw.	18	5	14	12	6.5	0.0	0.0
Hatteras	11	11	50	29.96	29.97	−.03	76.2	−1.8	86	9	81	64	25	72	15	72	70	82	7.25	+1.4	14	8,717	ne.	48	n.	25	9	8	14	5.9	0.0	0.0
Raleigh	376	103	110	29.60	29.99	−.02	73.8	−3.2	93	8	82	54	25	65	25	67	65	81	7.07	+1.2	13	4,630	ne.	36	sw.	18	6	11	14	6.5	0.0	0.0
Wilmington	78	81	91	29.91	29.99	−.01	76.2	−1.4	92	3	84	59	28	69	21	71	70	86	8.31	+1.8	17	4,536	sw.	23	sw.	18	3	15	13	6.9	0.0	0.0
Charleston	48	11	92	29.94	29.99	−.02	79.5	−1.5	95	9	86	62	28	72	22	74	72	83	8.79	+1.8	14	6,382	sw.	36	w.	1	9	14	8	5.4	0.0	0.0
Columbia, S. C.	351	41	57	29.62	29.99	−.02	77.1	−2.5	95	3	86	58	28	68	27	69	67	80	3.86	−2.9	10	4,121	ne.	20	s.	18	6	15	10	6.2	0.0	0.0
Due West	711	10	55	29.26	30.02	-----	75.8	-----	93	9	86	55	28	66	32	----	----	----	1.74	-----	10	5,425	sw.	40	w.	3	5	18	8	5.9	0.0	0.0
Greenville, S. C.	1,039	139	146	28.92	29.99	-----	74.8	−1.0	93	9	83	56	29	66	22	67	65	78	2.42	-----	8	5,618	ne.	33	ne.	25	3	20	8	6.3	0.0	0.0
Augusta	182	62	77	29.79	29.98	−.02	79.0	−1.4	95	8	88	59	28	70	27	72	70	81	1.71	−3.9	7	3,104	n.	26	sw.	3	5	18	8	5.5	0.0	0.0
Savannah	65	150	194	29.92	29.99	−.02	80.2	−0.5	95	8	88	60	28	72	27	73	71	84	6.20	−1.3	13	6,462	sw.	60	w.	25	8	13	10	5.8	0.0	0.0
Jacksonville	43	209	245	29.94	29.99	−.02	81.0	−0.7	94	4	88	66	28	74	21	74	72	80	1.98	−4.2	15	6,977	sw.	38	sw.	12	4	18	9	6.1	0.0	0.0
Florida Peninsula							83.5	+1.4										74	4.51	−2.0										5.0		
Key West	22	10	64	29.96	29.98	.00	85.1	+1.6	93	18	91	73	29	80	18	77	74	72	1.66	−3.0	12	5,111	se.	30	se.	15	13	13	5	4.5	0.0	0.0
Miami	25	71	79	29.98	30.01	-----	82.8	+1.4	90	13	88	71	26	77	18	75	73	73	4.40	−2.0	11	5,290	se.	28	n.	25	10	16	5	5.0	0.0	0.0
Tampa	35	79	87	29.96	29.99	−.01	82.6	+1.1	95	4	90	70	31	75	21	76	74	78	7.48	−1.1	15	3,441	e.	26	e.	8	2	20	9	5.8	0.0	0.0
Titusville	44	5	----	29.95	30.00	-----	82.0	-----	100	6	92	65	26	72	26	----	----	----	8.06	-----	15	------	sw.	----	----	----	10	12	9	4.8	0.0	0.0
East Gulf States							79.1	−0.8										76	4.03	−0.8										5.4		
Atlanta	1,173	190	216	28.79	30.00	−.01	75.9	−1.1	91	8	85	56	28	67	25	67	63	71	1.66	−2.8	9	5,892	nw.	23	nw.	15	7	14	10	5.6	0.0	0.0
Macon	370	78	87	29.59	29.98	−.03	78.0	−1.9	94	9	87	57	28	69	28	70	68	77	3.85	−0.4	10	3,451	ne.	25	s.	17	7	16	8	5.6	0.0	0.0
Thomasville	273	49	58	29.70	29.99	−.01	80.6	−0.4	96	6	90	61	28	71	26	73	70	80	3.40	−1.6	8	2,639	sw.	23	sw.	1	3	13	15	6.8	0.0	0.0
Apalachicola	36	42	49	29.94	29.98	-----	81.1	-----	93	25	87	69	27	75	17	75	73	78	3.83	-----	11	4,174	w.	21	se.	6	7	13	11	5.7	0.0	0.0
Pensacola	56	149	185	29.93	29.99	+.01	80.2	−0.7	95	15	87	66	26	74	20	74	71	77	5.01	−2.2	16	7,168	n.	42	e.	16	5	17	9	5.9	0.0	0.0
Anniston	741	9	57	29.24	30.02	+.03	76.4	0.0	94	17	88	51	21	65	33	----	----	----	1.38	−3.1	7	2,388	nw.	20	nw.	10	17	14	0	3.5	0.0	0.0
Birmingham	700	11	48	29.26	30.01	+.02	77.7	−1.5	94	2	88	55	21	67	28	69	66	76	3.51	−1.0	9	2,983	n.	27	w.	7	10	18	3	4.5	0.0	0.0
Mobile	57	125	161	29.93	30.00	+.02	81.1	+0.1	96	16	90	64	21	72	22	72	70	77	4.36	−2.4	12	5,434	n.	34	e.	18	6	10	15	6.3	0.0	0.0
Montgomery	223	100	112	29.76	30.00	+.01	80.0	−0.8	95	17	90	60	21	70	24	71	68	74	1.46	−2.8	8	3,771	ne.	26	n.	17	8	19	4	5.0	0.0	0.0
Corinth	469	6	----	-----	-----	-----	-----	-----	----	----	----	----	----	----	----	----	----	----	-----	-----	----	------	----	----	----	----	----	----	----	----	----	----
Meridian	375	87	95	29.61	29.99	+.01	78.2	−1.3	95	4	88	57	27	68	27	70	67	78	5.31	+1.8	14	2,809	sw.	25	nw.	17	5	19	7	5.6	0.0	0.0
Vicksburg	247	65	73	29.75	30.02	+.04	79.0	−1.8	94	14	87	60	27	71	22	71	67	74	5.92	+2.4	12	3,378	n.	22	n.	6	10	17	4	4.6	0.0	0.0
New Orleans	53	76	84	29.95	30.00	+.02	82.5	+0.3	96	16	90	70	21	76	19	74	71	74	8.52	+2.9	14	3,552	w.	20	ne.	30	9	14	8	5.4	0.0	0.0
West Gulf States							82.5	+0.6										70	1.63	−1.4										3.2		
Shreveport	249	77	93	29.73	29.99	+.02	82.6	+0.6	99	16	92	64	20	73	28	72	68	70	0.81	−1.4	6	4,134	se.	23	nw.	1	15	11	5	4.1	0.0	0.0
Bentonville	1,303	11	44	-----	-----	-----	72.7	−3.8	91	7	81	53	21	64	28	----	----	----	7.75	-----	16	2,727	se.	18	w.	16	6	15	10	----	0.0	0.0
Fort Smith	457	79	94	29.51	29.98	+.01	77.2	−3.3	97	16	85	58	21	69	27	70	68	77	4.93	+1.3	12	4,613	e.	53	nw.	17	9	11	11	5.6	0.0	0.0
Little Rock	357	136	144	29.63	30.00	+.02	76.6	−3.2	93	8	85	60	28	68	23	70	68	78	8.81	+5.2	15	4,449	s.	37	nw.	23	10	9	12	5.7	0.0	0.0
Austin	605	136	148	29.36	29.99	-----	85.4	+1.6	101	31	97	66	21	74	27	----	----	----	0.69	−1.6	2	5,498	se.	41	ne.	17	24	6	1	2.3	0.0	0.0
Brownsville	57	53	61	29.89	29.95	-----	84.4	+0.5	95	31	93	69	24	76	25	75	73	77	0.41	-----	3	5,303	s.	22	s.	11	25	6	0	2.2	0.0	0.0
Corpus Christi	20	11	73	29.95	29.97	+.04	84.0	+1.5	95	31	90	72	24	78	18	76	74	77	1.35	−0.9	3	9,129	se.	30	se.	8	23	7	1	2.6	0.0	0.0
Dallas	512	220	227	29.43	29.97	-----	83.4	-----	102	30	93	62	21	74	27	----	----	----	1.28	-----	2	8,133	s.	66	nw.	11	20	8	3	3.0	0.0	0.0
Fort Worth	670	106	114	29.25	29.95	+.01	84.8	+1.8	104	30	96	62	21	74	29	71	66	61	0.80	−1.9	5	6,648	s.	30	n.	23	16	13	2	3.6	0.6	0.0
Galveston	54	106	114	29.95	30.01	+.05	84.8	+1.8	92	18	89	75	23	81	14	75	72	71	0.02	−5.0	1	7,102	s.	36	e.	31	25	6	0	2.3	0.0	0.0
Groesbeck	461	11	56	29.50	29.97	-----	84.6	-----	103	31	96	62	21	73	31	----	----	----	0.17	-----	3	6,743	s.	27	sw.	31	18	12	1	2.9	0.0	0.0
Houston	138	292	314	29.86	30.00	-----	85.8	+3.2	102	31	96	68	20	76	26	----	----	----	T.	−4.1	0	7,450	s.	48	e.	31	27	4	0	2.4	0.0	0.0
Palestine	510	64	72	29.46	29.98	+.01	83.7	+1.9	99	31	94	62	21	73	27	72	67	65	0.01	−2.2	1	4,874	s.	21	ne.	25	13	17	1	3.8	0.0	0.0
Port Arthur	34	58	66	29.96	30.00	-----	84.0	-----	96	17	92	67	23	76	27	----	----	----	2.81	-----	10	5,183	s.	27	n.	31	23	7	1	2.6	0.0	0.0
San Antonio	693	119	132	29.24	29.94	+.01	86.0	+2.5	101	31	97	69	22	75	26	72	65	58	0.15	−2.5	1	5,422	s.	27	ne.	17	23	7	1	2.6	0.0	0.0
Taylor	583	55	63	29.40	30.01	+.06	84.6	+2.9	100	31	96	65	20	73	27	----	----	----	0.34	−2.1	1	5,848	s.	31	nw.	17	23	6	2	2.6	0.0	0.0

TABLE 1.—*Climatological data for Weather Bureau stations, August, 1927*—Continued

Districts and stations	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Stations, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01, or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles								0-10	In.	In.
Ohio Valley and Tennessee							70.2	−4.8										74	2.78	−0.6										5.2		
Chattanooga	762	189	213	29.19	29.98	−.02	75.4	−2.1	91	9	85	56	21	66	27	66	63	71	2.45	−1.3	10	3,793	nw.	30	nw.	19	6	21	4	4.9	0.0	0.0
Knoxville	995	102	111	28.97	30.01	.00	73.7	−2.5	91	7	83	54	28	64	26	66	64	80	4.55	+0.6	12	3,320	sw.	20	sw.	8	11	14	6	4.9	0.0	0.0
Memphis	399	76	97	29.58	30.00	+.02	75.6	−3.8	92	8	83	57	25	68	21	69	65	74	2.95	−0.2	11	3,902	n.	43	w.	2	11	10	10	5.1	0.0	0.0
Nashville	546	168	191	29.45	30.02	+.02	74.2	−3.6	91	8	84	56	26	64	30	66	62	70	1.86	−1.6	6	4,632	nw.	29	nw.	19	10	12	9	5.1	0.0	0.0
Lexington	989	193	230	28.97	30.02	+.01	69.5	−5.0	88	13	78	52	26	61	23				2.09	−1.5	9	7,047	e.	30	w.	8	17	6	8	4.3	0.0	0.0
Louisville	525	188	234	29.45	30.03	+.03	70.8	−6.2	89	7	80	54	25	62	27	63	59	72	2.92	−0.6	8	5,758	n.	29	nw.	13	13	10	8	4.5	0.0	0.0
Evansville	431	76	116	29.58	30.04	+.05	72.2	−5.2	88	1	81	53	24	63	24	64	60	71	1.64	−1.6	5	4,639	n.	30	nw.	13	8	18	5	4.9	0.0	0.0
Indianapolis	822	194	230	29.16	30.04	+.04	68.2	−5.5	90	7	77	49	24	59	27	60	55	67	2.64	−0.7	11	6,187	ne.	37	nw.	12	14	8	9	4.9	0.0	0.0
Royal Center	736	11	55	29.25	30.04		64.8		90	7	76	44	24	53	30				2.03		10	4,500	n.	35	sw.	7	14	8	9	4.6	0.0	0.0
Terre Haute	575	96	129	29.41	30.02		69.0		89	7	79	49	24	59	26	62	58	75	4.14		11	5,373	n.	26	n.	23	12	10	9	5.0	0.0	0.0
Cincinnati	627	11	51	29.36	30.03	+.02	68.3	−5.3	91	7	78	48	25	58	31	61	58	74	3.54	+0.2	10	3,617	ne.	19	ne.	23	14	10	7	4.5	0.0	0.0
Columbus	822	179	222	29.17	30.04	+.03	67.7	−5.3	90	7	76	50	25	59	26	61	58	73	1.91	−1.3	11	5,183	n.	30	n.	23	12	8	11	5.2	0.0	0.0
Dayton	899	137	173	29.09	30.02		68.0	−5.4	90	7	78	49	25	58	30	60	55	69	1.71	−1.3	11	4,563	ne.	32	n.	23	9	15	7	5.5	0.0	0.0
Elkins	1,947	59	67	28.02	30.04	+.02	63.3	−5.8	83	13	73	44	26	53	32	58	57	89	5.08	+1.4	15	2,462	w.	17	nw.	15	4	14	13	6.6	0.0	0.0
Parkersburg	637	77	82	29.39	30.04	+.03	68.7	−5.2	90	7	78	51	25	60	30	61	58	76	3.76	+0.2	10	2,995	n.	18	ne.	20	12	8	11	5.7	0.0	0.0
Pittsburgh	842	353	410	29.13	30.02	+.01	67.0	−5.9	86	13	76	50	25	58	26	59	55	72	1.86	−1.3	9	5,431	n.	32	nw.	19	5	13	13	6.7	0.0	0.0
Lower Lake Region							65.3	−4.4										69	2.15	−0.8										5.0		
Buffalo	767	247	280	29.19	30.01	+.02	64.4	−4.2	82	13	71	51	16	58	20	59	56	74	1.84	−1.2	8	8,595	sw.	40	w.	30	7	15	9	5.6	0.0	0.0
Canton	448	10	61	29.50	29.97		62.7	−5.1	83	22	72	43	15	53	31				3.11	+0.4	12	5,122	sw.	27	w.	29	15	8	8	4.3	0.0	0.0
Oswego	335	76	91		29.99	.00	64.0	−4.4	84	7	71	51	26	57	26			75	3.31	+0.6	13	5,512	s.	29	n.	14	12	10	9		0.0	0.0
Rochester	523	86	102	29.45	30.02	+.03	65.0	−4.2	88	7	74	48	25	56	31	58	54	71	2.69	−0.3	15	4,871	sw.	37	sw.	8	7	14	10	5.8	0.0	0.0
Syracuse	597	97	113	29.37	30.01	+.02	65.0	−3.6	83	7	73	49	26	57	25				3.20	−0.1	12	5,400	s.	30	nw.	16	4	15	12	6.5	0.0	0.0
Erie	714	130	166	29.26	30.02	+.01	65.3	−4.3	85	7	73	49	25	58	23	58	53	66	1.21	−2.0	9	6,479	nw.	29	s.	7	13	13	5	4.2	0.0	0.0
Cleveland	762	190	201	29.22	30.03	+.02	65.4	−4.6	86	7	72	52	10	59	23	58	53	64	0.70	−2.4	6	7,212	n.	43	n.	9	9	15	7	5.5	0.0	0.0
Sandusky	629	5	67	29.36	30.04	+.03	67.1	−4.7	91	7	76	50	25	58	28				2.21	−1.2	7	4,440	ne.	30	nw.	7	9	16	6	5.1	0.0	0.0
Toledo	628	208	243	29.36	30.04	+.04	66.6	−4.7	88	7	76	47	2	58	27	59	54	67	2.20	−0.5	10	6,782	n.	27	sw.	7	16	9	6	3.9	0.0	0.0
Fort Wayne	856	113	124	29.12	30.04		66.2	−4.9	91	7	76	46	24	56	31	56	53	68	1.76		9	3,996	n.	26	sw.	6	17	7	7	3.9	0.0	0.0
Detroit	730	218	258	29.26	30.05	+.04	66.6	−3.7	87	7	75	50	24	58	24	58	53	65	1.06	−1.7	6	5,270	n.	29	sw.	7	9	11	11	5.6	0.0	0.0
Upper Lake Region							62.5	−3.8										71	1.00	−2.0										4.3		
Alpena	609	13	92	29.38	30.05	+.05	60.4	−3.7	86	6	71	40	2	50	33	56	52	73	0.50	−2.8	5	7,042	nw.	33	nw.	1	15	13	3	4.1	0.0	0.0
Escanaba	612	54	60	29.38	30.04	+.05	59.6	−4.7	78	6	69	43	24	50	29	54	51	74	1.45	−2.2	4	6,615	n.	32	nw.	6	11	16	4	4.3	0.0	0.0
Grand Haven	632	54	89	29.36	30.04	+.05	62.0	−5.1	83	14	72	43	24	52	30	57	53	72	1.12	−1.5	5	5,731	n.	26	nw.	1	16	12	3	3.8	0.0	0.0
Grand Rapids	707	70	87	29.29	30.05	+.05	65.7	−4.0	87	7	78	44	24	54	31	56	49	60	0.66	−1.9	7	2,992	nw.	17	nw.	8	8	12	11	5.8	0.0	0.0
Houghton	668	64	99	29.32	30.04	+.07	60.2	−3.5	78	31	69	45	15	51	28				0.79	−2.1	7	6,045	w.	31	w.	8	15	12	4	4.1	0.0	0.0
Lansing	878	11	62	29.10	30.04		64.1	−4.4	91	7	78	40	2	50	33	56	51	68	0.21	−2.4	5	2,420	n.	17	nw.	8	13	14	4	4.3	0.0	0.0
Ludington	637	60	66	29.35	30.05		61.0		78	13	69	45	2	53	24	56	53	75	1.01		3	5,952	s.	29	s.	22	20	7	4	2.9	0.0	0.0
Marquette	734	77	111	29.25	30.05	+.07	60.6	−3.2	81	31	69	44	15	52	30	55	52	74	0.41	−2.4	6	6,264	w.	27	nw.	1	8	14	9	5.6	0.0	0.0
Port Huron	638	70	120	29.34	30.03	+.03	63.8	−4.0	84	8	73	48	2	55	26	58	54	72	0.52	−2.1	6	6,034	ne.	32	n.	8	12	16	3	4.0	0.0	0.0
Sault Sainte Marie	614	11	52	29.35	30.04	+.05	59.6	−2.5	79	21	69	39	2	50	32	54	51	77	0.40	−2.7	4	5,341	nw.	31	nw.	8	16	11	4	4.2	0.0	0.0
Chicago	673	7	131	29.33	30.05	+.05	66.7	−4.9	86	6	73	55	19	60	24	60	56	72	3.17	+0.3	10	6,304	ne.	28	n.	1	15	10	6	4.4	0.0	0.0
Green Bay	617	109	141	29.38	30.04	+.05	63.4	−4.3	84	6	74	43	24	53	28	56	51	69	0.59	−2.5	4	5,905	s.	30	w.	6	10	15	6	4.8	0.0	0.0
Milwaukee	681	125	221	29.32	30.06	+.06	66.1	−3.1	88	6	74	50	24	58	27	58	54	68	0.58	−2.2	6	8,044	n.	48	nw.	4	12	15	4	3.8	0.0	0.0
Duluth	1,133	5	47	28.84	30.06	+.09	60.2	−2.4	80	5	70	42	23	50	28	54	50	75	2.50	−0.9	12	8,003	ne.	36	w.	3	15	12	4	3.9	0.0	0.0
North Dakota							64.6	−1.6										68	2.92	+0.6										4.0		
Moorhead	940	50	58	28.99	30.00	+.04	64.6	−1.5	88	5	77	39	23	52	38	57	52	69	2.02	−1.1	6	4,984	s.	24	s.	26	17	7	7	4.1	0.0	0.0
Bismarck	1,674	8	57	28.23	29.99	+.05	66.4	−0.9	92	5	78	45	19	55	37	57	52	68	3.12	+1.1	7	5,524	e.	42	sw.	26	17	9	5	4.2	0.0	0.0
Devils Lake	1,478	11	44	28.44	30.00	+.06	62.8	−2.3	91	5	76	34	23	50	35	55	50	69	2.98	+0.2	11	5,151	se.	33	nw.	5	20	4	7	3.8	0.0	0.0
Ellendale	1,457	10	56	28.46	30.01		64.6		89	5	76	41	9	53	39				3.40		9	7,562	s.	34	s.	26	11	12	8	5.1	0.0	0.0
Grand Forks	833	12	67				63.2		92	5	76	37	23	51	43	57			5.97		10		se.	22	ne.	17	14	10	7	3.6	0.0	0.0
Williston	1,878	41	48	28.03	29.98	+.05	64.5	−1.6	88	5	78	38	8	51	38	55	49	64	3.54	+2.2	11	3,970	se.	27	sw.	26	15	14	2	3.4	0.0	0.0
Upper Mississippi Valley							68.7	−4.0										70	2.19	−1.1										4.7		
Minneapolis	918	102	208	29.05	30.02		67.0	−2.9	88	31	77	46	23	57	29				2.11	−1.6	5	6,435	n.	28	n.	8	14	10	7	4.7	0.0	0.0
St. Paul	837	236	261	29.14	30.04	+.07	65.8	−3.6	86	14	76	45	24	55	31				1.95	−1.5	8	6,531	se.	30	s.	27	14	12	5	4.5	0.0	0.0
La Crosse	714	11	48	29.28	30.04	+.06	64.8	−5.2	88	6	77	44	24	53	31	58	54	75	3.03	−0.4	9	2,135	s.	14	s.	21	14	10	7	4.6	0.0	0.0
Madison	974	70	78	29.02	30.05	+.06	66.4	−3.4	88	6	76	49	2	57	26	58	52	66	0.46	−2.8	6	4,330	n.	24	nw.	8	13	12	6	4.5	0.0	0.0
Wausau	1,247	4		28.74	30.07		61.6		84	6	74	38	24	49	35				1.12		6		n.				13	10	8	5.0	0.0	0.0
Charles City	1,015	10	49	28.98	30.05	+.08	66.0	−3.1	92	6	79	41	9	53	34	58	52	67	1.74	−1.7	6	3,352	se.	23	w.	21	15	11	5	4.0	0.0	0.0
Davenport	606	71	79	29.38	30.04	+.06	69.6	−3.5	92	6	80	51	9	60	25	60	56	68	3.28	−0.4	8	3,496	e.	28	e.	13	16	11	4	4.5	0.0	0.0
Des Moines	861	84	97	29.13	30.03	+.06	69.8	−3.3	95	6	80	50	24	59	31	60	56	66	1.61	−2.0	7	3,832	n.	31	sw.	7	8	13	10	5.8	0.0	0.0
Dubuque	700	81	96	29.30	30.04	+.06	67.2	−4.5	92	6	78	46	9	56	30	58	53	65	1.47	−1.6	6	3,119	n.	23	n.	8	14	10	7	4.5	0.0	0.0
Keokuk	614	64	78	29.37	30.04	+.06	70.6	−4.4	93	6	80	53	20	61	27	62	58	68	3.10	−0.1	8	2,833	e.	44	sw.	7	9	14	8	5.0	0.0	0.0
Cairo	358	87	93	29.64	30.01	+.07	73.8	−4.0	89	1	82	57	24	66	22	66	63	77	1.57	−1.4	8	4,693	n.	35	n.	13	9	12	10	5.6	0.0	0.0
Peoria	609	11	45	29.40	30.06	+.07	68.5	−4.0	91	6	79	48	24	58	31	61	58	74	1.45	−1.5	9	2,658	ne.	24	sw.	7	20	6	5	3.3	0.0	0.0
Springfield, Ill.	636	10	91	29.36	30.03	+.04	69.6	−4.9	91	6	79	53	3	60	26	63	59	74	3.37	+0.6	6	4,260	e.	26	w.	13	14	8	9	4.6	0.0	0.0
Hannibal	534	74	109	29.46	30.02	+.04	70.3	−4.7	92	6	80	52	20	61	27				2.92	−0.5	8	4,128	sw.	22	n.	8	15	7	9	4.8	0.0	0.0
St. Louis	568	265	303	29.43	30.03	+.04	72.2	−5.1	91	6	80	53	3	64	22	64	59	69	2.60	−0.1	9	5,258	n.	62	sw.	7	11	11	9	4.9	0.0	0.0
Missouri Valley							69.8	−4.2										71	4.32	+0.9										5.1		
Columbia, Mo.	784	11	84	29.20	30.02	+.05	70.0	−5.6	91	6	79	53	24	61	26				5.01	+2.0	11	3,543	se.	20	nw.	8	11	11	9	5.1	0.0	0.0
Kansas City	963	161	181	29.00	30.02	+.05	71.4	−5.2	91	6	79	55	9	64	22	64	60	72	5.11	+0.4	15	5,576	s.	40	n.	11	9	15	7	5.2	0.0	0.0
St. Joseph	967	11	49	28.99	30.01		71.4		90	6	81	53	9	62	27	64	60	75	4.46		12	3,823	se.	28	nw.	22	14	12	5	4.2	0.0	0.0
Springfield, Mo.	1,324	98	104	28.60	29.98	+.01	70.5	−5.2	89	13	78	53	25	63	24	65	62	80	8.68	+4.4	11	5,330	s.	30	nw.	14	14	14	3	3.9	0.0	0.0
Iola	984	11	50	28.98	30.01	+.05	71.8	−5.3	93	6	82	54	20	62	27				9.11	+5.8	12	3,044	ne.	24	nw.	22	12	9	10	5.3	0.0	0.0
Topeka	987	92	107				70.9	−5.3	94	6	80	54	20	62	24				6.80	+2.5	17	4,737	ne.	31	n.	8	11	8	12	5.8	0.0	0.0
Lincoln	1,189	11	84	28.78	30.02	+.07	69.8	−4.6	90	5	79	49	20	60	30	62	58	73	3.08	−0.6	13	5,483	se.	37	nw.	10	3	16	12	6.9	0.0	0.0
Omaha	1,105	115	122	28.86	30.02	+.06	70.4	−4.0	92	6	79	52	9	62	24	62	57	68	2.35	−1.3	12	4,170	se.	31	n.	8	8	17	6	5.2	0.0	0.0
Valentine	2,598	47	54	27.35	30.03	+.09	68.0	−3.7	91	30	80	42	19	56	38	59	54	67	1.73	−1.1	11	5,564	s.	30	sw.	10	10	15	6	4.9	0.0	0.0
Sioux City	1,135	94	164	28.84	30.03	+.08	68.4	−3.6	93	6	78	46	9	59	30	61	56	70	1.90	−1.1	10	6,230	s.	33	s.	26	11	13	7	5.4	0.0	0.0
Huron	1,306	59	74	28.64	30.02	+.07	67.6	−1.8	93	5	80	42	9	56	40	61	56	65	2.37	−0.3	9	5,656	s.	37	s.	9	17	11	3	3.7	0.0	0.0
Pierre	1,572	70	75		29.97	+.06	70.4	−2.4	95	5	81	47	23	60	34			65	2.88	+0.9	9	4,706	se.	56	n.	11	13	12	6		0.0	0.0
Yankton	1,233	49	57	28.71	30.01	+.06	67.8	−4.2	94	6	78	44	9	58	32				2.77	−0.4	12	3,734	e.	21	se.	26	5	18	8	5.8	0.0	0.0

TABLE 1.—*Climatological data for Weather Bureau Stations, August, 1927*—Continued

Districts and stations	Elevation of instruments			Pressure			Temperature of the air									Mean wet thermometer	Mean temperature of the dew point	Mean relative humidity	Precipitation			Wind					Clear days	Partly clouded days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Barometer above sea level	Thermometer above ground	Anemometer above ground	Station, reduced to mean of 24 hours	Sea level, reduced to mean of 24 hours	Departure from normal	Mean max. + mean min. ÷ 2	Departure from normal	Maximum	Date	Mean maximum	Minimum	Date	Mean minimum	Greatest daily range				Total	Departure from normal	Days with 0.01, or more	Total movement	Prevailing direction	Maximum velocity: Miles per hour	Maximum velocity: Direction	Maximum velocity: Date						
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles.								0-10	In.	In.
Northern Slope							63.7	−2.7										66	2.23	+1.0										5.0		
Billings	3,140	5					64.4		91	5	80	34	31	48	48				1.70		12		nw.				11	9	11		0.0	0.0
Havre	2,505	11	44	27.38	29.98	+.07	65.6	+0.2	90	11	79	45	28	52	44	55	48	61	0.39	−0.9	6	3,648	sw.	29	nw.	4	15	13	3	4.2	0.0	0.0
Helena	4,110	87	112	25.86	30.00	+.06	62.4	−2.6	86	6	74	38	31	50	35	53	48	68	2.91	+2.2	15	5,288	sw.	40	sw.	26	4	17	10	6.3	0.0	0.0
Kalispell	2,973	48	56	26.94	29.95	+.02	62.8	0.0	85	11	75	43	13	50	33	53	46	61	0.92	0.0	10	4,200	nw.	34	ne.	16	17	9	5	4.2	0.0	0.0
Miles City	2,371	48	55	27.50	30.02	+.09	68.6	−2.9	95	12	82	47	1	56	39	57	50	59	2.54	+1.5	7	3,417	ne.	28	se.	26	23	6	2	3.2	0.0	0.0
Rapid City	3,259	50	58	26.68	30.05	+.12	65.0	−4.5	86	26	75	47	19	55	31	57	52	69	3.18	+1.1	14	4,407	w.	33	nw.	7	6	20	5	5.4	0.0	0.0
Cheyenne	6,088	84	101	24.13	30.01	+.09	61.8	−3.8	82	25	73	44	17	51	31	52	47	68	4.04	+2.6	15	6,053	s.	36	n.	24	7	12	12	6.0	0.0	0.0
Lander	5,372	60	68	24.75	30.02	+.10	62.1	−3.4	85	5	76	39	27	48	41	51	43	58	0.49	0.0	11	3,753	sw.	40	nw.	26	11	16	4	4.8	0.0	0.0
Sheridan	3,790	10	47	26.16	30.02		62.4		86	12	76	41	31	48	40	54	51	76	2.52		14	2,499	s.	30	nw.	26	12	12	7	5.0	0.0	0.0
Yellowstone Park	6,241	11	48	24.00	30.04	+.11	55.9	−5.0	78	5	70	33	31	42	38	46	39	62	2.21	+1.2	16	4,753	s.	33	sw.	10	5	20	6	5.5	0.0	0.0
North Platte	2,821	11	51	27.14	30.02	+.08	68.7	−2.1	92	5	80	45	19	58	34	60	57	74	3.41	+1.0	12	4,222	se.	26	nw.	21	13	8	10	4.9	0.0	0.0
Middle Slope							71.2	−4.7										74	4.92	+2.5										5.2		
Denver	5,292	106	113	24.85	30.08	+.11	66.6	−4.1	86	24	77	52	18	56	31	56	50	67	2.75	+1.4	19	4,417	s.	34	nw.	11	8	17	6	5.3	0.0	0.0
Pueblo	4,685	80	86	25.39	30.01	+.10	69.3	−3.4	89	24	81	53	17	58	34	58	53	68	2.50	+0.9	14	4,213	e.	32	nw.	15	11	16	4	5.2	0.0	0.0
Concordia	1,392	50	58	28.56	30.01	+.06	70.4	−6.1	93	6	79	52	20	62	28	64	61	77	7.74	+4.9	12	4,291	s.	40	ne.	11	6	19	6	5.8	0.0	0.0
Dodge City	2,509	11	51	27.45	30.01	+.08	71.8	−5.9	91	12	82	52	19	62	28	65	62	79	5.98	+3.4	11	5,874	se.	33	s.	15	14	10	7	4.5	0.0	0.0
Wichita	1,358	139	158	28.58	29.99	+.04	72.4	−5.9	92	7	81	56	19	64	24	66	63	78	5.90	+2.8	14	6,795	s.	50	sw.	8	10	16	5	5.0	0.0	0.0
Broken Arrow	765	11	56	29.18	30.00		74.4		92	16	83	57	27	66	27				7.64		18	6,478	se.	36	n.	17	10	12	9	5.5	0.0	0.0
Oklahoma City	1,214	10	47	28.72	29.97	+.03	76.8	−2.9	97	7	86	59	19	68	30	69	67	77	4.65	+1.5	12	5,860	s.	36	w.	16	6	17	8	5.4	0.0	0.0
Southern Slope							81.2	+1.6										55	1.72	−0.6										3.0		
Abilene	1,738	10	52	28.17	29.92	.00	84.8	+2.8	102	8	97	63	20	72	31	68	60	51	0.66	−1.2	4	6,571	s.	27	w.	11	19	11	1	2.7	0.0	0.0
Amarillo	3,676	10	49	26.32	29.97	+.05	75.4	−0.3	98	7	88	57	3	63	32	64	59	68	5.31	+2.5	13	6,157	s.	27	sw.	6	17	11	3	3.9	0.0	0.0
Del Rio	944	64	71	28.92	29.88	−.02	86.4	+2.2	103	17	97	70	25	76	26	70	62	51	0.38	−2.2	2	7,732	se.	38	ne.	17	23	7	1	2.0	0.0	0.0
Roswell	3,566	75	65	26.39	29.91	+.03	78.2	+1.6	97	1	91	59	27	65	37	62	54	51	0.54	−1.4	4	4,989	s.	40	e.	3	17	14	0	3.3	0.0	0.0
Southern Plateau							76.8	−0.6										57	1.12	0.0										3.7		
El Paso	3,778	152	175	26.20	29.88	+.04	79.8	+0.6	98	1	91	64	21	69	30	64	56	50	1.34	−0.4	10	6,912	e.	39	ne.	9	18	11	2	3.5	0.0	0.0
Santa Fe	7,013	38	53	23.39	29.92	+.03	66.8	−0.6	85	1	78	49	21	55	31	54	48	61	3.41	+1.0	15	4,050	sw.	24	n.	22	7	18	6	5.0	0.0	0.0
Flagstaff	6,907	10	59	23.48	29.92	+.08	62.3	−0.5	85	10	76	42	31	50	40	52		71	4.43		15	4,801	nw.	28	nw.	28	3	19	9		0.0	0.0
Phoenix	1,108	10	82	28.70	29.82	+.03	87.8	−0.7	111	9	100	68	29	75	39	70	62	49	0.69	−0.3	6	3,556	e.	36	nw.	28	17	10	4	3.8	0.0	0.0
Yuma	141	9	54	29.66	29.80	+.04	90.5	+0.1	118	10	104	70	30	77	40	74	66	52	0.14	−0.2	3	3,612	sw.	30	s.	10	21	7	3	2.4	0.0	0.0
Independence	3,957	5	25	25.93	29.88	+.07	73.4	−2.7	97	9	92	46	30	55	46	55			T.	−0.1	0		nw.				25	6	0		0.0	0.0
Middle Plateau							69.7	−1.4										40	1.24	+0.4										3.3		
Reno	4,532	74	81	25.49	29.90	+.06	68.4	+1.4	95	4	86	42	14	51	41	51	37	39	0.22	−0.1	1	5,105	w.	33	w.	12	27	4	0	1.6	0.0	0.0
Tonopah	6,090	12	20				70.6		87	4	82	47	14	59	28	50	32	27	T.		0		se.									
Winnemucca	4,344	18	56	25.63	29.95	+.07	67.2	−2.1	97	5	86	33	14	48	46	50	37	40	0.24	+0.1	2	4,364	sw.	30	nw.	3	23	8	0	3.1	0.0	0.0
Modena	5,473	10	43	24.67	29.90	+.04	67.6	−1.6	90	10	82	45	31	53	39	52	40	46	3.41	+1.6	11	8,078	sw.	44	s.	18	21	6	4	3.2	0.0	0.0
Salt Lake City	4,360	163	203	25.63	29.91	.00	73.2	−1.3	93	1	84	54	14	62	30	55	42	38	0.87	+0.1	5	6,310	s.	41	sw.	9	15	11	5	4.0	0.0	0.0
Grand Junction	4,602	60	68	25.44	29.97	+.07	72.0	−3.4	92	1	84	54	27	60	32	56	47	48	1.45	+0.4	15	4,637	se.	37	se.	11	12	12	7	4.6	0.0	0.0
Northern Plateau							70.6	+0.6										42	0.47	+0.1										3.4		
Baker	3,471	48	53	26.46	29.99	+.04	64.6	0.0	91	10	80	38	31	49	39	51	39	46	0.19	−0.2	7	3,996	se.	23	sw.	1	16	11	4	3.7	0.0	0.0
Boise	2,739	78	86	27.14	29.93	.00	71.6	−0.2	95	9	86	45	31	58	37	54	40	39	0.35	+0.2	3	3,085	nw.	24	sw.	10	24	5	2	2.4	0.0	0.0
Lewiston	757	40	48	29.12	29.92	−.03	74.0	+1.2	102	19	89	48	31	59	42				0.92	+0.6	8	2,086	e.	25	nw.	2	18	7	6	3.6	0.0	0.0
Pocatello	4,477	60	68	25.50	29.93	+.01	68.5	−1.1	92	5	82	42	31	55	38	52	40	42	0.44	−0.1	9	5,782	se.	44	sw.	11	14	14	3	4.3	0.0	0.0
Spokane	1,929	101	110	27.93	29.94	−.01	70.2	+2.1	93	8	83	45	13	58	34	55	44	45	0.37	−0.2	4	2,291	s.	19	e.	22	16	13	2	3.9	0.0	0.0
Walla Walla	991	57	65	28.87	29.93	−.03	74.6	+1.9	98	17	87	53	13	62	34	57	43	38	0.57	+0.1	5	3,350	s.	23	sw.	22	21	6	4	2.8	0.0	0.0
North Pacific Coast Region							63.7	+1.5										69	0.99	+0.1										5.2		
North Head	211	11	56	29.82	30.04	+.01	58.3	+0.7	69	16	62	51	8	55	14	50	55	92	2.20	+1.3	9	8,377	n.	39	s.	31	3	6	22	8.1	0.0	0.0
Port Angeles	29	8	53	30.00	30.03		58.6		84	16	67	45	6	50	31				0.46	−0.2	5	3,810	sw.	22	w.	31	12	11	8	4.2	0.0	0.0
Seattle	125	215	250	29.87	30.00	.00	65.0	+1.9	89	17	74	51	28	56	29	58	52	69	1.03	+0.4	8	4,894	nw.	37	s.	31	11	10	10	5.0	0.0	0.0
Tacoma	194	172	201	29.82	30.02	.00	65.6	+2.9	90	17	75	49	28	56	31				0.40	−0.3	9	4,847	n.	32	sw.	31	7	13	11	6.0	0.0	0.0
Tatoosh Island	86	9	53	29.92	30.02	+.02	55.0	−0.3	68	16	58	48	14	52	17	54	53	95	2.47	+0.4	6	8,756	s.	39	s.	31	6	6	19	7.3	0.0	0.0
Yakima	1,071	5					71.7		99	5	89	37	30	54	46	58		58	0.01		1		nw.				12	17	2	4.3	0.0	0.0
Medford	1,425	4		¹28.44	¹29.92		69.8		99	16	88	42	31	51	44	55	45	50	T.		0		nw.				26	4	1		0.0	0.0
Portland, Oreg	153	68	106	29.84	30.00	−.01	69.2	+2.5	96	16	80	49	12	58	29	59	53	62	0.35	−0.3	5	3,829	nw.	16	sw.	31	15	7	9	4.6	0.0	0.0
Roseburg	510	75	99	29.45	29.99	−.01	69.1	+1.1	100	16	84	47	31	54	42	57	48	56	0.03	−0.3	1	3,203	n.	18	n.	13	23	5	3	1.9	0.0	0.0
Middle Pacific Coast Region							66.4	−0.5										67	T.	0.0										3.0		
Eureka	62	73	89	29.98	30.05	+.05	56.6	+0.6	66	25	61	48	13	52	15	54	52	88	0.02	−0.1	2	3,652	nw.	20	n.	26	7	8	16	6.6	0.0	0.0
Red Bluff	332	50	56	29.54	29.88	+.02	78.0	−1.7	104	10	94	51	29	62	38	61	48	40	0.00	0.0	0	3,058	se.	19	se.	22	29	2	0	0.5	0.0	0.0
Sacramento	69	106	117	29.83	29.90	+.05	71.6	−1.3	99	20	88	53	29	56	43	59	52	57	T.	0.0	0	6,294	s.	22	s.	22	30	1	0	0.3	0.0	0.0
San Francisco	155	208	243	29.80	29.97	+.05	59.8	+0.7	81	31	66	51	9	54	26	56	53	82	T.	0.0	0	6,402	w.	29	w.	15	11	13	7	5.1	0.0	0.0
San Jose	141	12	110	29.82	29.97		65.9	−0.8	88	31	78	47	30	54	40				T.	0.0	0	4,535	nw.	22	nw.	28	18	13	0	2.6	0.0	0.0
South Pacific Coast Region							70.7	−0.7										66	T.	0.0										1.9		
Fresno	327	89	98	29.54	29.88	+.06	79.0	−1.7	105	9	96	57	29	62	39	60	46	38	T.	0.0	0	5,878	nw.	24	nw.	22	31	0	0	0.5	0.0	0.0
Los Angeles	338	159	191	29.58	29.93	+.05	70.4	−0.7	89	24	80	56	1	60	25	61	58	72	T.	0.0	0	3,585	sw.	14	sw.	28	27	4	0	1.8	0.0	0.0
San Diego	87	62	70	29.83	29.92	+.03	69.0	+0.3	78	25	74	61	11	64	15	64	61	81	0.01	0.0	1	4,570	w.	18	nw.	31	20	11	0	2.8	0.0	0.0
San Luis Obispo	201	32	40	29.76	29.98	+.04	64.5	−0.6	85	24	76	48	29	53	34	56	51	73	T.	0.0	0	2,739	nw.	15	nw.	30	24	7	0	2.5	0.0	0.0
West Indies																																
San Juan, P. R.	82	9	54	29.87	29.95		80.3	−0.2	91	22	85	71	1	75	18				4.82	−2.6	21	7,950	e.	34	e.	3	9	17	5	5.0	0.0	0.0
Panama Canal																																
Balboa Heights	118	7	97	29.72	29.84	.00	80.2	−1.0	90	20	86	72	6	74	15	76	75		7.76	−0.3	20	4,581	nw.	24	n.	20	0	10	21	7.8	0.0	0.0
Colon	38	7	97	29.80	29.84	.00	81.4	+1.2	90	20	87	72	11	76	15	77	76		26.63	+11.5	25	6,346	nw.	31	s.	10	0	3	28	8.9	0.0	0.0
Alaska																																
Juneau	80	11	54	¹29.91	¹30.00		58.4		75	19	66	47	22	51	27	54	52	81	5.46		14	4,280	s.	27	nw.	17	7	6	18	6.5	0.0	0.0
Hawaiian Islands																																
Honolulu	38	86	100	¹29.97	¹30.01		78.2		85	26	83	71	18	74	12	70	66	68	0.80	−0.4	13	7,402	e.	28	ne.	2	9	20	2	4.3	0.0	0.0

¹ Pressure not corrected to mean of 24 hours.

TABLE 2.—*Data furnished by the Canadian Meteorological Service, August, 1927*

Stations	Altitude above mean sea level, Jan. 1, 1919	Pressure			Temperature of the air						Precipitation		
		Station reduced to mean of 24 hours	Sea level reduced to mean of 24 hours	Departure from normal	Mean max. + mean min. ÷2	Departure from normal	Mean maximum	Mean minimum	Highest	Lowest	Total	Departure from normal	Total snowfall
	Feet	*In.*	*In.*	*In.*	*°F.*	*°F.*	*°F.*	*°F*	*°F*	*°F*	*In.*	*In.*	*In.*
Cape Race, N. F.	99												
Sydney, C. B. I.	48												
Halifax, N. S.	88												
Yarmouth, N. S.	65												
Charlottetown, P. E. I.	38												
Chatham, N. B.	28												
Father Point, Que.	20	29.89	29.91	.00	56.6	+1.0	64.1	49.2	79	42	1.42	−1.63	0.0
Quebec, Que.	296	29.64	29.96	+.03	63.0	−0.1	71.4	54.7	82	44	2.76	−1.07	0.0
Doucet, Que.	1,236												
Montreal, Que.	187	29.75	29.95	.00	64.8	−1.6	72.8	56.8	83	48	3.02	−0.55	0.0
Ottawa, Ont.	236	29.71	29.97	+.01	64.2	−0.6	74.6	53.9	84	45	2.30	−0.73	0.0
Kingston, Ont.	285	29.68	29.99	+.01	64.1	−2.9	71.3	56.9	77	48	1.85	−0.53	0.0
Toronto, Ont.	379	29.60	30.00	+.01	64.9	−1.1	74.7	55.0	85	48	1.47	−1.29	0.0
Cochrane, Ont.	930												
White River, Ont.	1,244	28.69	30.00	+.04	53.6	−2.8	68.2	39.0	76	30	1.70	−1.60	0.0
London, Ont.	808				63.7		76.3	51.1	87	40	0.94		0.0
Southampton, Ont.	656	29.32	30.03	+.04	60.6	−3.2	70.4	50.9	82	40	0.90	−1.35	0.0
Parry Sound, Ont.	688	29.31	29.99	+.01	61.3	−2.2	71.0	51.6	81	40	1.08	−1.64	0.0
Port Arthur, Ont.	644	29.33	30.04	+.08	60.1	+0.6	71.5	48.7	84	39	2.21	−0.54	0.0
Winnipeg, Man.	760												
Minnedosa, Man.	1,690	28.20	29.99	+.05	60.0	+0.6	71.3	48.8	85	32	4.28	+2.18	0.0
Le Pas, Man.	860				60.3		72.2	48.4	82	29	2.14		0.0
Qu'Appelle, Sask.	2,115	27.74	29.96	+.03	61.6	+0.1	74.9	48.3	87	35	1.81	+0.17	0.0
Moose Jaw, Sask.	1,759				63.5		80.1	46.9	94	30	0.59		0.0
Swift Current, Sask.	2,392	27.47	29.96	+.03	62.6	−1.4	78.6	46.5	90	30	2.84	+0.93	0.0
Medicine Hat, Alb.	2,144	27.67	29.89	−.03	65.2	−0.5	77.7	52.8	90	43	5.80	+4.13	0.0
Calgary, Alb.	3,428	26.49	30.02	+.11	60.0	+0.6	72.4	47.6	85	40	2.81	+0.67	0.0
Banff, Alb.	4,521	25.48	30.00	+.09	55.6	−0.7	69.0	42.3	81	35	2.42	−0.11	0.0
Prince Albert, Sask.	1,450	28.44	30.00	+.08	60.9	+2.0	73.4	48.5	86	37	1.33	−0.82	0.0
Battleford, Sask.	1,592	28.24	29.96	+.05	62.8	+0.2	77.2	48.4	87	34	1.28	−1.08	0.0
Edmonton, Alb.	2,150	27.68	29.94	+.02	60.9	+2.1	74.4	47.5	85	37	0.81	−1.32	0.0
Kamloops, B. C.	1,262	28.68	29.94	+.03	69.8	+1.2	83.3	56.4	94	51	1.72	+0.63	0.0
Victoria, B. C.	230	29.74	29.99	−.02	60.1	+1.4	67.8	52.5	85	49	0.48	−0.12	0.0
Barkerville, B. C.	4,180	25.73	30.00	+.10	55.8	−0.5	68.1	43.5	79	34	2.00	−1.10	0.0
Estevan Point, B. C.	20				56.8		62.4	51.3	72	47	4.03		0.0
Prince Rupert, B. C.	170				59.1		67.9	50.3	79	43	4.09		0.0
Hamilton, Ber.	151	29.97	30.13	+.03	80.6	+1.0	88.4	72.8	92	71	4.40	−1.68	0.0

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Father Point, Que.	20	29.86	29.88	+.03	59.7	+2.1	66.9	52.6	83	46	5.92	+2.88	0.0
Kingston, Ont.	285	29.64	29.95	−.02	65.6	−2.6	70.7	60.5	85	46	4.65	+1.76	0.0
Port Arthur, Ont.	644	29.29	30.00	+.06	62.4	+0.4	72.1	52.8	87	40	3.01	−0.47	0.0
Minnedosa, Man.	1,690	28.21	29.99	+.06	62.2	0.0	72.4	51.9	87	34	2.66	+0.06	0.0
Kamloops, B. C.	1,262	28.76	30.02	+.08	70.9	+2.4	84.7	57.1	103	47	0.99	−0.62	0.0
Barkerville, B. C.	4,180	25.80	30.09	+.18	54.6	−0.5	66.1	43.2	80	36	3.35	+0.33	0.0
Prince Rupert, B. C.	170				58.6		67.9	49.3	83	44	1.93		0.0
Hamilton, Ber.	151	30.09	30.25	+.11	77.6	−1.1	84.6	70.6	88	62	3.44	−1.00	0.0

Chart I. Tracks of Centers of Anticyclones, August, 1927. (Inset) Departure of Monthly Mean Pressure from Normal
(Plotted by Wilfred P. Day)

Chart I. Tracks of Centers of Anticyclones, August, 1927. (Inset) Departure of Monthly Mean Pressure from Normal

(Plotted by Wilfred P. Day)

Chart II. Tracks of Centers of Cyclones, August, 1927. (Inset) Change in Mean Pressure from Preceding Month

(Plotted by Wilfred P. Day)

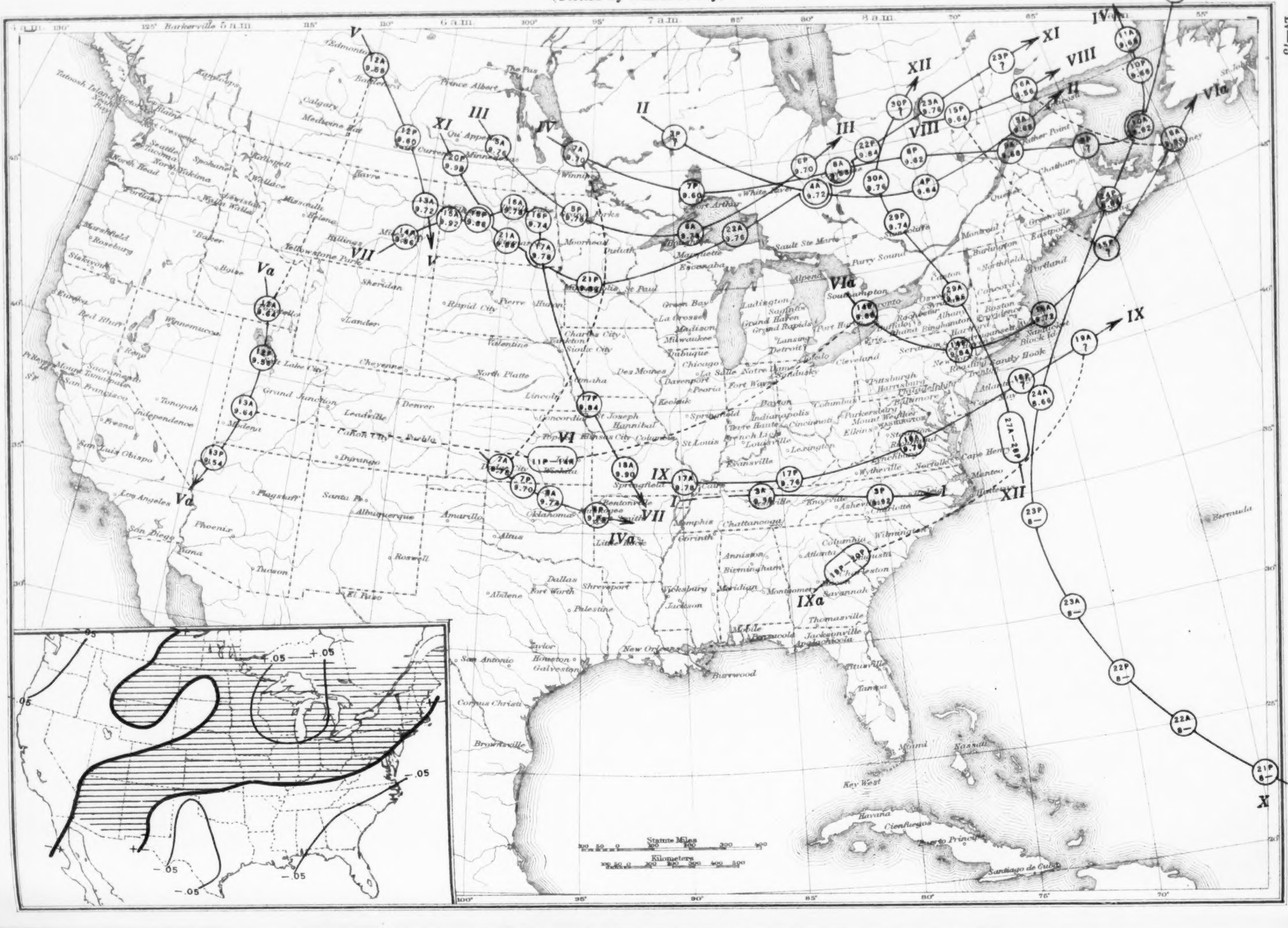

Chart III. Departure (°F.) of the Mean Temperature from the Normal, August, 1927

Chart III. Departure (°F.) of the Mean Temperature from the Normal, August, 1927

Chart IV. Total Precipitation, Inches, August, 1927. (Inset) Departure of Precipitation from Normal

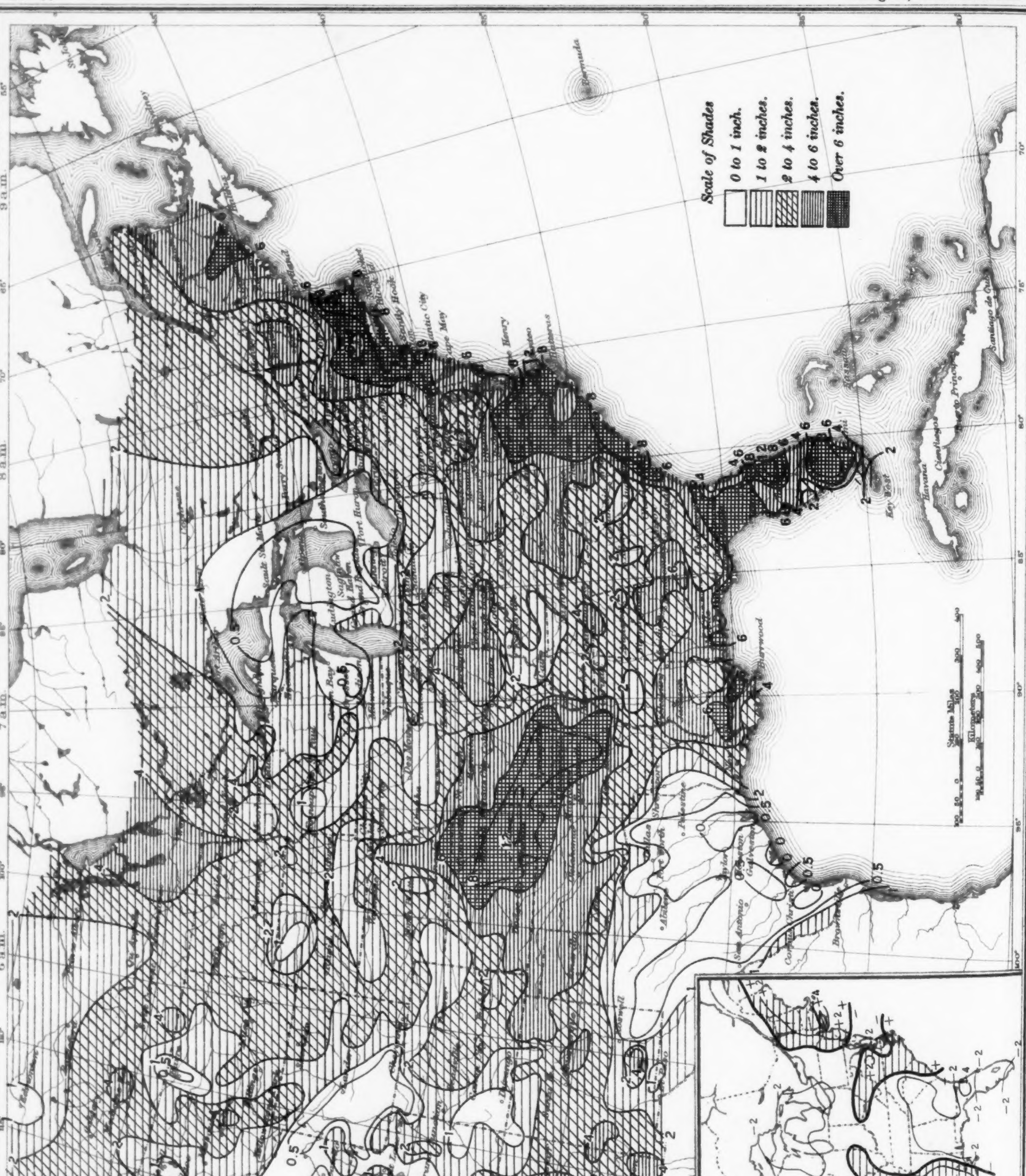

Chart V. Percentage of Clear Sky between Sunrise and Sunset, August, 1927

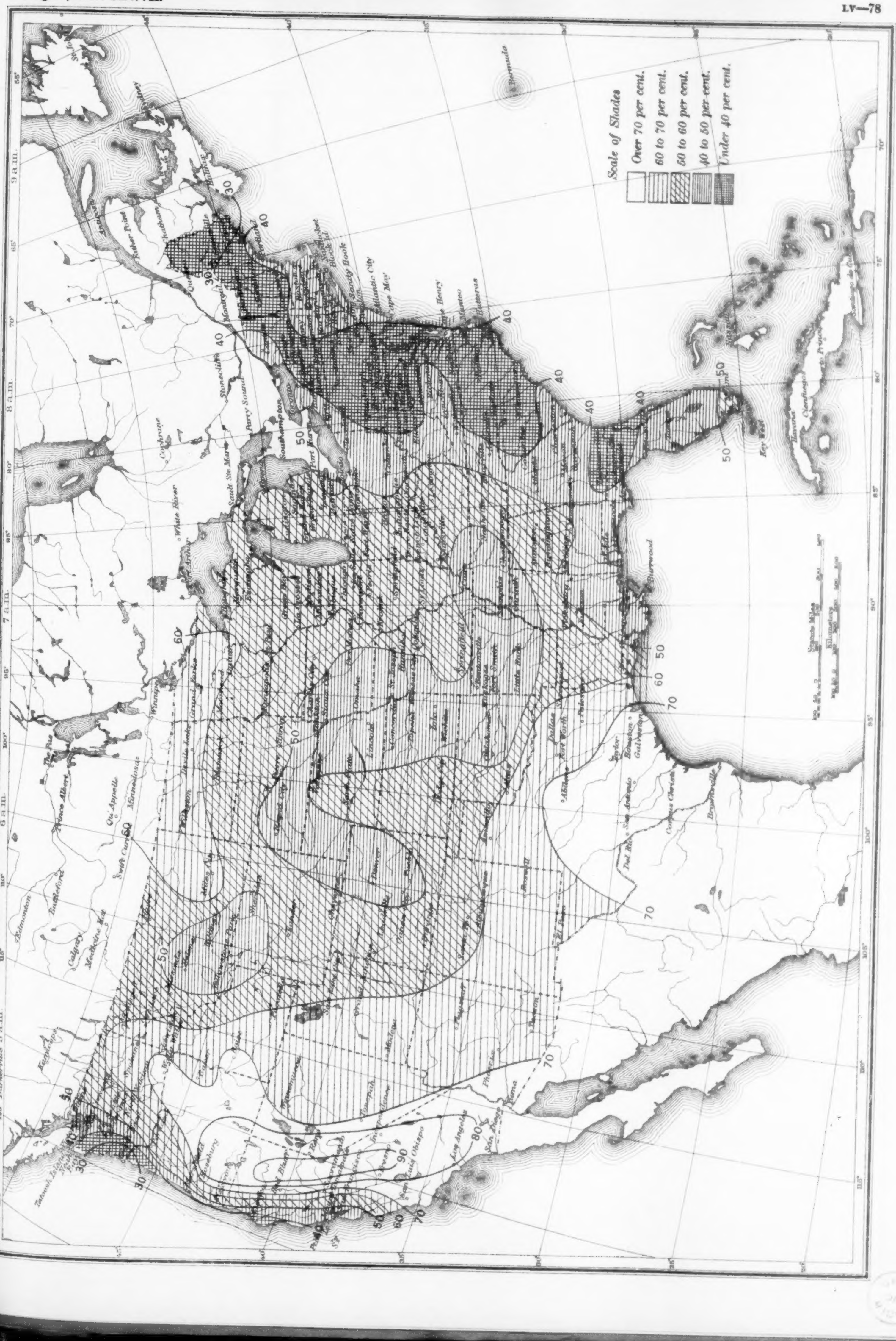

Chart VI. Isobars at Sea level and Isotherms at Surface; Prevailing Winds, August, 1927

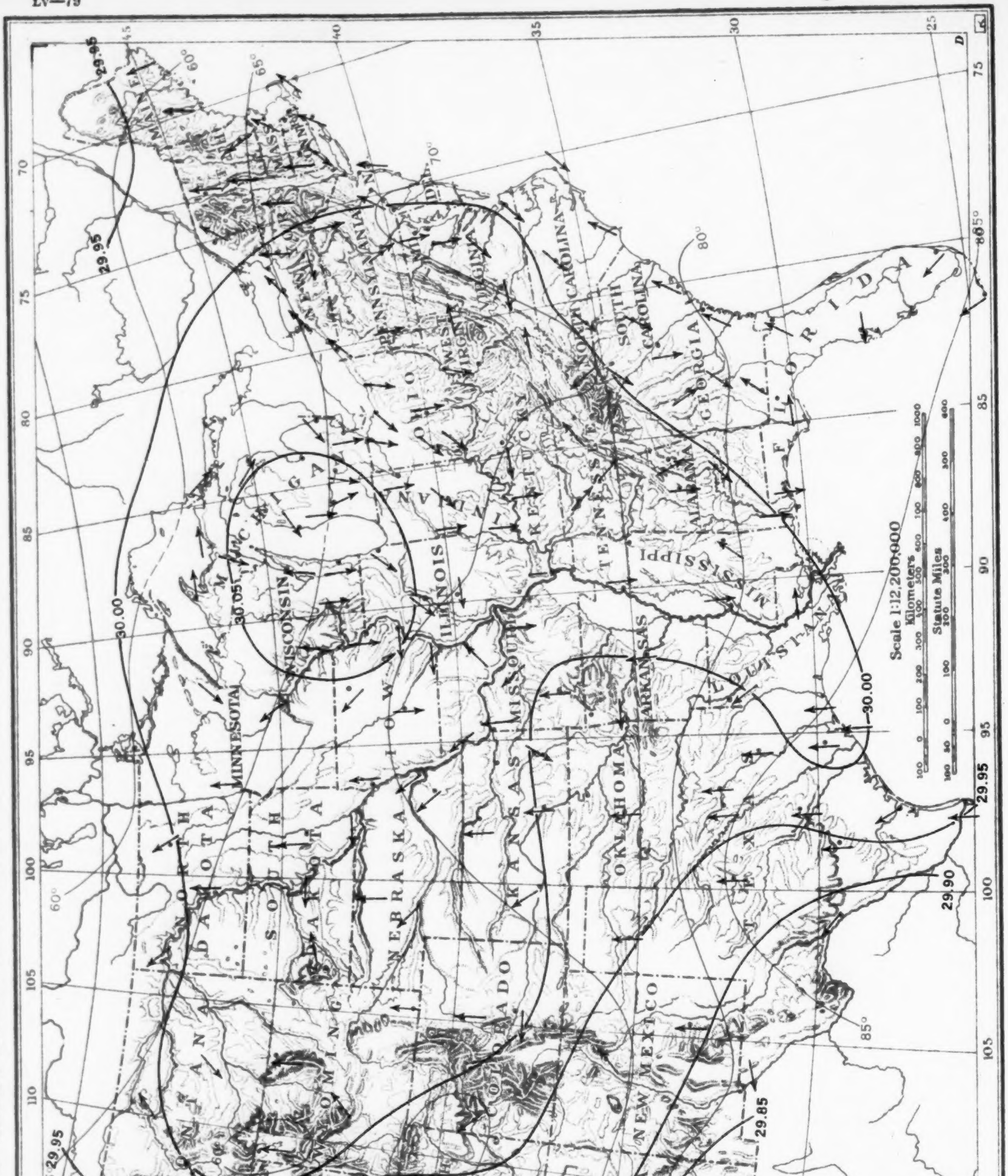

Chart VIII. Weather Map of North Atlantic Ocean, August 22, 1927

Chart VIII. Weather Map of North Atlantic Ocean, August 22, 1927
(Plotted by F. A. Young)

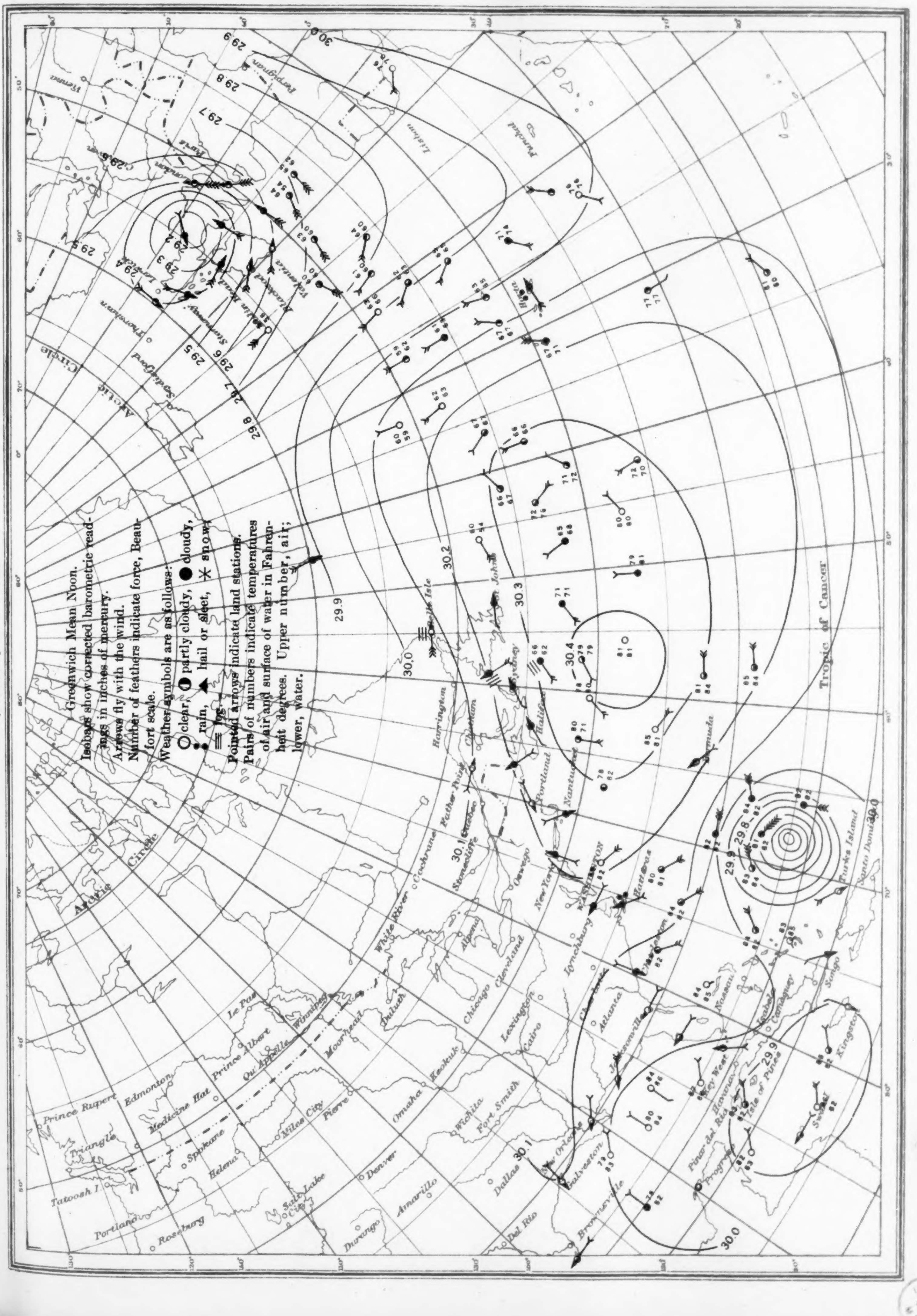

Chart IX. Weather Map of North Atlantic Ocean, August 23, 1927

(Plotted by F. A. Young)

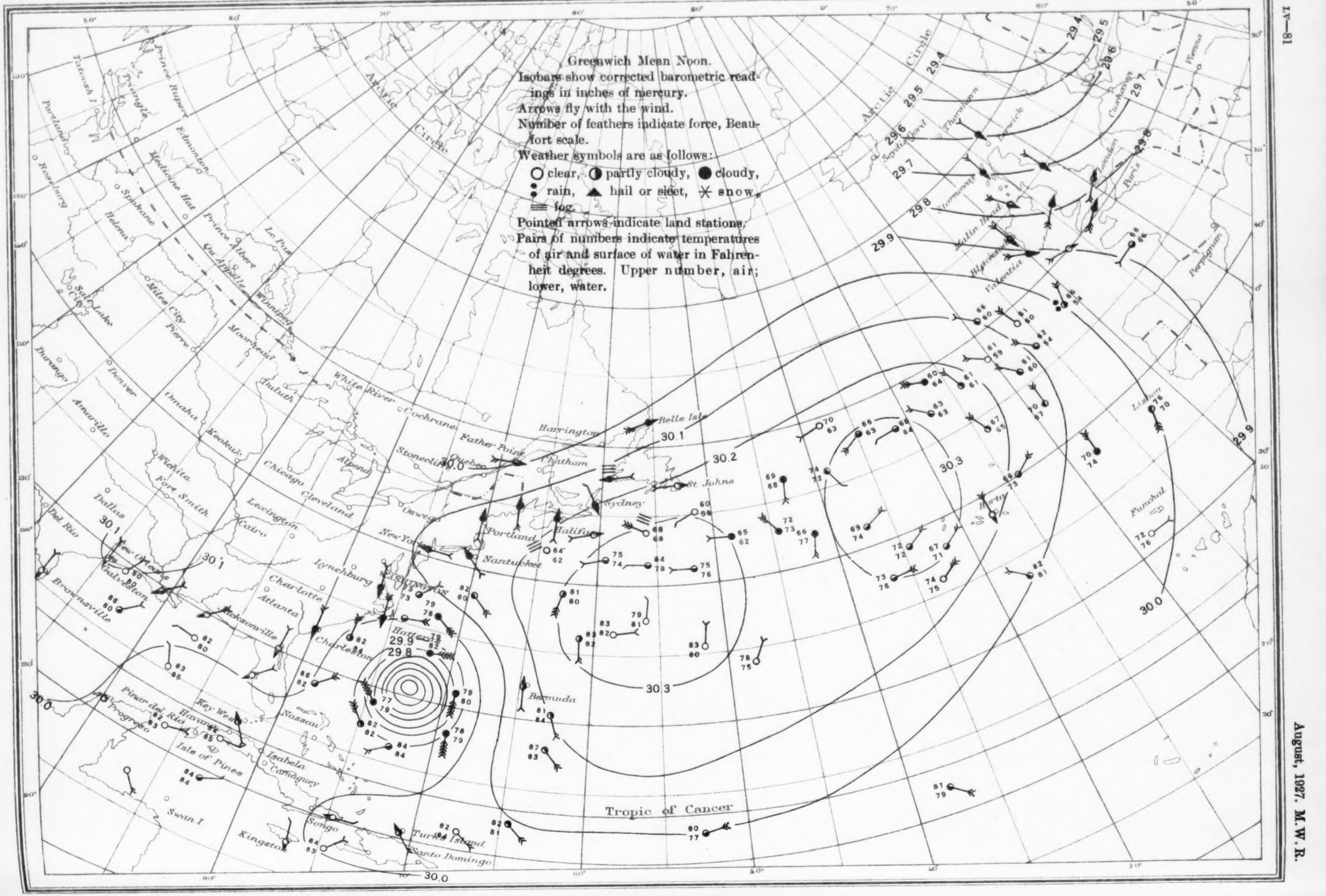

Chart X. Weather Map of North Atlantic Ocean, August 24, 1927

(Plotted by F. A. Young)

Chart X. Weather Map of North Atlantic Ocean, August 24, 1927
(Plotted by F. A. Young)

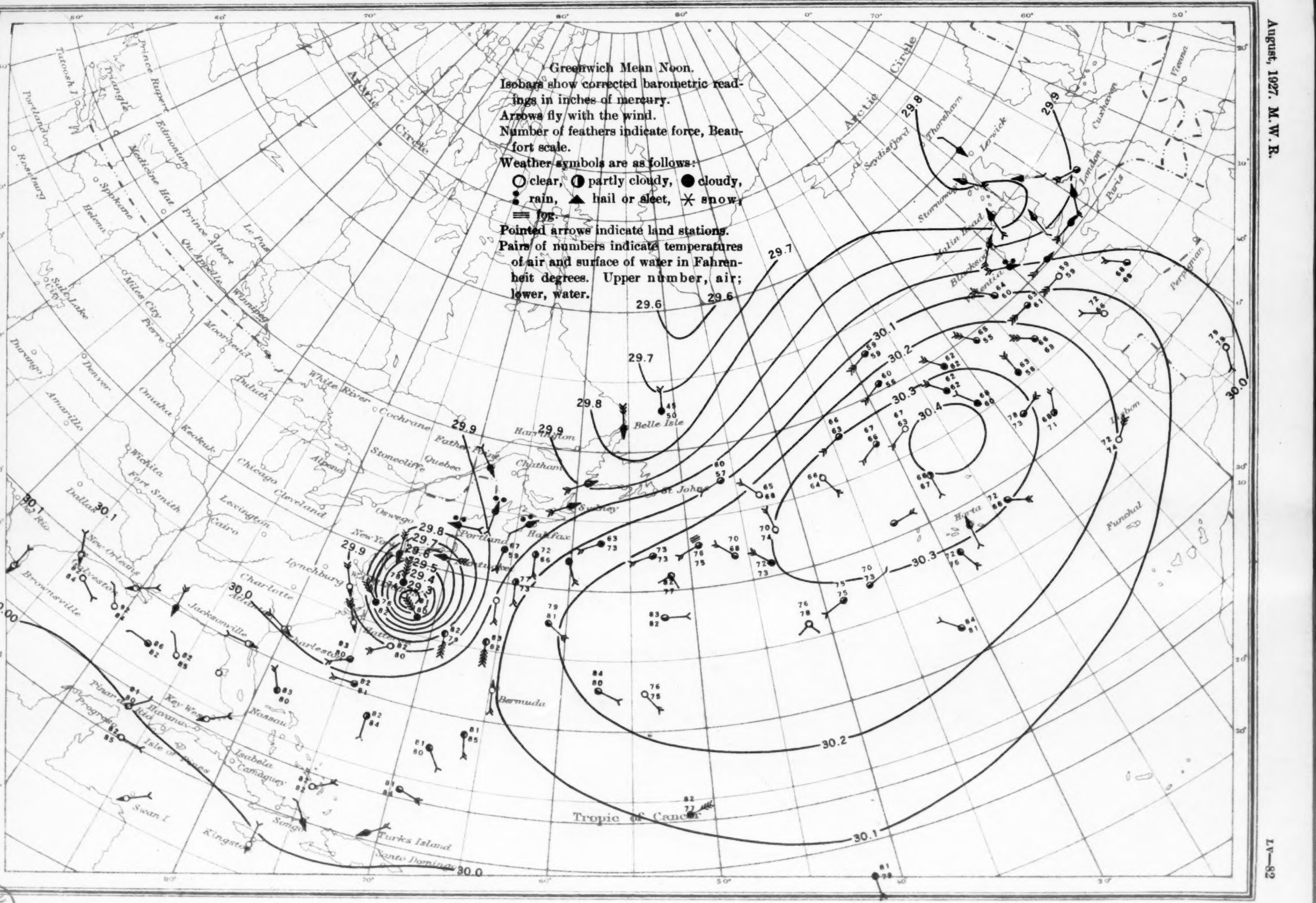

Chart XI. Weather Map of North Atlantic Ocean, August 25, 1927

(Plotted by F. A. Young)